Language and Computers Topic 6: Dialogue Systems	Outline	Language and Computers Topic 6: Dialogue Systems	What are dialogue systems good for?	Language and Computers Topic 6: Dialogue Systems
Introduction Early Systems ELZA Hose ELZA works PARY SHOLU How Does Dialogue How Does Dialogue Work? Basic Facts Grease Maxime Description Discourse Structure Parter Corpora Modeling discourse Dialogue System Components TRIPS	Introduction Early Systems How Does Dialogue Work? Dialogue System Components	Introduction Early Systems ELZA Hoe ELZA works PMRY SHOLU How Does Dialogue Work? Basic Fects Grean Maxims Speech Acts Pann Recognism Discourse Structure Reference Modeling discourse Dialogue System Components TRIPS	<ul> <li>We can book airline tickets over the phone without dealing with error-prone humans.</li> <li>We can interact with our computer while keeping our hands free.</li> <li>We can talk to a system that won't have the same predujices a human might ( depending on the programmer)</li> <li>When robots someday take over the world, we'll be able to understand their demands</li> </ul>	Introduction Early Systems Euza Hee ELIZA works Heart How Does Dialogue Work? Basic Fairs Grozen Maxims Speen-Assi Speen-Assi Grozen Maxims Diacogue System Corporents Dialogue System Components Trans
1/75 Language and Computers Topic 6: Dialogue Systems	ELIZA	2/75 Language and Computers Topic 6: Dialogue Systems	Example conversation	3/75 Language and Computers Topic 6: Dialogue Systems
Introduction Entry Systems ELZA New ELZA works MARY SHIDLU How Does Dialogue Work? Basic Facts Gream Maxims Speech Acts Para Recognisin Discourse Structure Reference Corpon Modeling discourse Dialogue System Components THIPS	<ul> <li>ELIZA was a computer program written by Joseph Weizenbaum in the mid-1960s</li> <li>Simulation of a (Rogerian) therapist.</li> <li>User types questions, and ELIZA responds. http://www.manifestation.com/neurotoys/eliza.php3</li> </ul>	Introduction Early Systems Eizz Hote LL2A works PARRY SRBUU How Does Dialogue Work? Basic Fasts Gricean Maxims Speech Acts Pan Recognition Discourse Structure Reterance Corpora Modeling discourse Dialogue System Components Traines	<ul> <li>Taken from Weizenbaum's 1966 paper:</li> <li>USER: Men are all alike.</li> <li>ELIZA: IN WHAT WAY?</li> <li>USER: They're always bugging us about something or other</li> <li>ELIZA: CAN YOU THINK OF A SPECIFIC EXAMPLE?</li> <li>USER: Well, my boyfriend made me come here.</li> <li>ELIZA: YOUR BOYFRIEND MADE YOU COME HERE</li> <li>USER: He says I'm depressed much of the time.</li> <li>ELIZA: I AM SORRY TO HEAR YOU ARE DEPRESSED</li> <li>USER: It's true. I am unhappy</li> <li>ELIZA: DO YOU THINK COMING HERE WILL HELP YOU NOT TO BE UNHAPPY</li> <li>USER: I need some help, that much seems certain.</li> </ul>	Introduction Early Systems ELIZA How ELIZA works PARRY
WORK / Basic Facts Grease Maxims Speech Acts Pain Recognition Discourse Switzleve Reference Compoor Modeling discourse Dialogue System Componentis Trainis	<ul> <li>Properties of ELIZA</li> <li>What do you notice about ELIZA?</li> <li>Seems to show some understanding of English. <ul> <li>e.g. "What resemblance do you see?"</li> </ul> </li> <li>Seems to have some understanding of real-world problems. <ul> <li>e.g. "Tell me more about your family."</li> <li>Seems to keep track of the conversation</li> <li>e.g. "Does that have anything to do with"</li> </ul> </li> </ul>	Language and Compute and Systems Introduction Early Systems Early Media Calanders Back Back Back Back Back Back Back Back	<ol> <li>Four types of responses</li> <li>A general question or statement Does that trouble you?, Beware of addictions.</li> <li>A transformed version of the previous statement Your father.</li> <li>A reponse relevant to the topic of the previous statement Do you think coming here will help you?</li> </ol>	Construction Co
	Computers Topic Systems Introduction Early Systems Introduction How Does Dialogue Warr? Bace free System State System State System State Dialogue System Components Tares Dialogue System Components Tares Dialogue System Components Tares Dialogue System Components Tares Dialogue System Components Tares Dialogue System Components Tares Dialogue System Components Tares Dialogue System Components Tares Dialogue System Components Dialogue System Dialogue System Dialogue System Dialogue System Dialogue System Dialogue System Dialogue System Dialogue System	Current Systems     Current International Introduction       Targe Systems     Introduction       Early Systems     How Does Dialogue Work?       Dialogue System Components     Dialogue System Components       Targe Systems     ELIZA       Targe Systems     ELIZA       ELIZA     ELIZA       Systems     Simulation of a (Rogerian) therapist.       Introduction of a (Rogerian) therapist.     User types questions, and ELIZA responds.       Targe Systems     Viscon types of the station com/neurotoys/eliza.php3       Targe Systems     Viscon types questions, and ELIZA responds.       Targe Systems     Simulation of a (Rogerian) therapist.       Targe Systems     Simulation con/neurotoys/eliza.php3       Targe Systems     Simulation of a (Rogerian) therapist. <t< td=""><td>Current Park Bringson North Bringson Watcher Bringson Brin</td><td>Current With Large Gualdogue Systems     What Large Gualdogue Systems global lof?       Introduction     Entry Systems       Haw Does Dialogue Work?     We can book airline lickets over the phone without dealing with error-prone humans.       Dialogue Systems Components     We can book airline lickets over the phone without dealing with error-prone humans.       We can book airline lickets over the phone without dealing with error-prone humans.     We can book airline lickets over the phone without dealing with error-prone humans.       We can book airline lickets over the world, we li be able to understand their demands     We can book airline lickets over the world, we li be able to understand their demands       We can book airline lickets over the world, we li be able to understand their demands     We can all is to a system component the programment       We can book airline lickets over the world, we li be able to understand their demands     We can all is to a system component the phone without demands       We can book airline lickets over the world, we li be able to understand their demands     We can all is to a system component the program withen by Joseph without demands       With diameter demands     Simulation of a (Rogerian) therapist.     User types quesions, and ELIZA responds. Humans and their demands       With do you notice about ELIZA     Simulation of a (Rogerian) therapist.     User types quesions, and ELIZA responds. Humans and the diameter demands       Wat do you notice about ELIZA     Simulation of a (Rogerian) therapist.     User types quesions, and ELIZA responds. Humans and the system of the pr</td></t<>	Current Park Bringson North Bringson Watcher Bringson Brin	Current With Large Gualdogue Systems     What Large Gualdogue Systems global lof?       Introduction     Entry Systems       Haw Does Dialogue Work?     We can book airline lickets over the phone without dealing with error-prone humans.       Dialogue Systems Components     We can book airline lickets over the phone without dealing with error-prone humans.       We can book airline lickets over the phone without dealing with error-prone humans.     We can book airline lickets over the phone without dealing with error-prone humans.       We can book airline lickets over the world, we li be able to understand their demands     We can book airline lickets over the world, we li be able to understand their demands       We can book airline lickets over the world, we li be able to understand their demands     We can all is to a system component the programment       We can book airline lickets over the world, we li be able to understand their demands     We can all is to a system component the phone without demands       We can book airline lickets over the world, we li be able to understand their demands     We can all is to a system component the program withen by Joseph without demands       With diameter demands     Simulation of a (Rogerian) therapist.     User types quesions, and ELIZA responds. Humans and their demands       With do you notice about ELIZA     Simulation of a (Rogerian) therapist.     User types quesions, and ELIZA responds. Humans and the diameter demands       Wat do you notice about ELIZA     Simulation of a (Rogerian) therapist.     User types quesions, and ELIZA responds. Humans and the system of the pr

Four types of responses (cont.)	Language and Computers Topic 6: Dialogue Systems	How ELIZA works	Language and Computers Topic 6: Dialogue Systems	1. Transform input	Language and Computers Topic 6: Dialogue Systems
<ol> <li>A reproduction of an earlier statement ELIZA: FIRST TELL ME WHY YOU HAVE COME HERI USER: To talk to a computer ELIZA: TO TALK TO A COMPUTER USER: Yes, to talk to a computer http://www.cogs.sussex.ac.uk/local/books/computers- and-thought/chap2 /node2.html</li> </ol>	Introduction Early Systems Euz Aware and a system Second and a system How Does Dialogue Work? Basic Facts Groson Maxims Speech Aris Diacours Structure Reference Corpor Modeling discourse Dialogue System Components Truips	<ul> <li>They are many different implementations of ELIZA out there, but they all work in the same general way:</li> <li>1. Transform input to change the point of view (<i>I</i> and <i>you</i>)</li> <li>2. Perform pattern recognition (pattern matching)</li> <li>3. Substitute keywords into canned phrases, or submit a general canned phrase</li> </ul>	Introduction Early Systems ELZA Have ELZA works How Does Dialogue Work? Basic Faits Grocen Maxims Speech Ats Pan Recognition Diacours Structure Reference Corpore Modeling discourse Dialogue System Components TRIPS	<ul> <li>you becomes <i>I</i> (and vice versa)</li> <li>my becomes your (and vice versa)</li> <li>adjustments are made for <i>I</i> to be turned into me → if a sentence ends in <i>I</i>, change it to me.</li> <li>USER: If I could explain to you I could explain anything to anyone</li> <li>ELIZA: IF YOU COULD EXPLAIN TO I YOU COULD EXPLAIN ANYTHING TO ANYONE</li> </ul>	Introduction Early Systems ELCA Here ELCA work Paper How Does Dialogue Work? Base Fast Graam Marins Systeh Ard Pare Reception Dialogue System Compon Dialogue System Components Trans
	10/75		11/75		12/75
<ul> <li>2. Pattern recognition</li> <li>If a pattern matches the transformed input, choose one of those reponses. Otherwise choose a general purpose response.</li> <li>See want in user's statement → respond with: beware of addictions</li> <li>See need in user's statement → respond with: can you do without</li> <li>user's statement eliza is a very simple program matches the template X is Y template = a specified pattern with slots to be filled in</li> </ul>	Language and Computers Systems Introduction Early Systems Euza Hearly Systems Euza Hearly Systems Companies Companies Speech Acta Para Recognition Discourse Structure Reference Corpora Modeling Genores Dialogue System Components Trains	<ul> <li>3. Canned phrases</li> <li>Everything ELIZA says is some sort of canned phrase.</li> <li>ELIZA does not "build up" a sentence from words; rather, it spits out a single phrase, perhaps composed of a few patterns.</li> </ul>	Language and Computers Topic 6: Dialogue Systems ELZA Here ELZA works PARRY SHOLU How Doos Dialogue Work? Basic Fash Grocen Maxim Speech Acts Para Recognition Diacours Binuclare Reference Corpora Modeling discursis Dialogue System Components Traips	Choices in ELIZA User enters <i>I wouldn't pay money for a computer.</i> ► <i>money</i> matches one pattern ► <i>computer</i> matches another pattern ⇒ ELIZA picks one pattern at random	Language and Computers Topic 6: Dialogue Systems EuXA ExcX ExcX ExcX ExcX ExcX ExcX ExcX ExcX
<ul> <li>Why does ELIZA work so well?</li> <li>User assumptions/expectations: if you're looking for a Rogerian psychotherapist, you may find what you expected.</li> <li>In theory, pattern matching can match a lot of user statements, given a large database of patterns.</li> <li>The way conversation works was taken into account when creating ELIZA Respond with something related to the previous statement; use some of the same vocab the other person did; etc.</li> </ul>	13/75 Language and Computers To Systems Euro Antroduction Early Systems Euro Marry Sinclu Marry Bac Add Antro Antr	<ul> <li>How can we tell that ELIZA isn't a human?</li> <li>Lack of initiative</li> <li>Lack of knowledge ELIZA knows nothing about the real world</li> <li>Lack of common sense</li> <li>Lack of true grammar/syntax = structure of sentences Say <i>you peabrain</i> to it and you might get <i>me peabrain</i> back. Need two separate patterns for <i>Computers worry me</i> <i>very little</i>. and <i>I'm not worried much by computers</i>.</li> <li>Doesn't have (much of) a memory</li> </ul>	14/73  Language and Computers  Discourse  Language and Computers  Language and	Effect of ELIZA People became somewhat emotionally involved with the system. Weizenbaum's secretary asked him to leave the room while she talked with ELIZA	Lisr75 Language and Computers Topic 4: Dialogue Systems Liza Mary Horr Does Dialogue Work? Horr Does Dialogue Work? Horr Does Dialogue Work? Horr Does Dialogue Dialogue System Components Traves
	16/75		17/75		18/75

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PARRY	Language and Computers Topic 6: Dialogue Systems	SHRDLU	Language and Computers Topic 6: Dialogue Systems	From Then Until Now	Language and Computers Topic 6: Dialogue Systems
<ul> <li>PARRY (Colby et al 1971)</li> <li>keeps track of "global" emotional state</li> <li>when the <i>anger</i> variable is high, for example, PARRY will choose from a set of "hostile" options.</li> <li>"With Parry, Dr. Colby established that a computer chip could be programmed to imitate a paranoid schizophrenic." http://www.edu-cyberpg.com/Linguistics/Parry.html</li> </ul>	Introduction Eurly Systems ELZA How ELIZA works How ELIZA works How ELIZA works SHEQLU How Does Dialogue Work? Basic Facts Gricsan Marine Speech Antis Plan Recognition Discourse Structure Reference Components TRIPS	<ul> <li>SHRDLU (Winograd 1972)</li> <li>simulated a robot who could manipulate toy blocks ("The BLOCKS World")</li> <li>e.g. <i>Move the red block on top of the smaller green one.</i></li> <li>used an extensive English grammar</li> <li>used some logical representation of meaning http://hci.stanford.edu/~winograd/shrdlu/</li> <li>p.s. Name comes from the fact that some keyboards used to represent the more frequent letters in English together: ETAOIN SHRDLU</li> </ul>	Introduction Early Systems ELZA How ElZA How ElZA How ElZA How ElZA How ElZA How Does Dialogue Work? Basic Facts Grican Numins Speech Anti Corpora Homory Bruchure Plan Recognition Discourse Bruchure Components Thips	<ul> <li>ELIZA was a very simple pattern-matcher, and PARRY and SHRDLU were only somewhat more complex. They're just "chatterbots"</li> <li>There has been a push to add linguistic and real-world knowledge to dialogue systems</li> <li>So, instead of focusing on systems, we will focus on what a dialogue system needs to know in order to work.</li> </ul>	Introduction Early Systems ELIZA Hote ELIZA works Parene Work? Basic Faris Grinam Antonics Speech Acts Plan Recognition Discourse Structure Reference Corpora Corpora Components TRIPS
	19/75	<u> </u>	20/75		21/75
How does dialogue work?	Language and Computers Topic 6: Dialogue Systems	Basic facts about dialogues	Language and Computers Topic 6: Dialogue Systems	Basic facts about dialogues (cont.)	Language and Computers Topic 6: Dialogue Systems
<ul> <li>How does discourse (= conversation) work?</li> <li>Basic facts about dialogues</li> <li>Gricean maxims</li> <li>Speech acts</li> <li>Plan recognition</li> <li>Discourse structure</li> <li>Reference</li> </ul>	Introduction Early Systems ELIZA How ELIZA How ELIZA How ELIZA How BLIZA How BLIZA How BLIZA How Build How Does Dialogue Work? Batch Fats Grican Maulins Speech Arts Plan Recognition Dialogue System Components TRIPS	<ul> <li>Turn-taking: must know when it's the right time to contribute your turn Comes naturally to humans: overlaps and long pauses are actually somewhat rare</li> <li>Adjacency pairs: two-part conversational structures where turn-taking is usually quite clear e.g. question/answer, greeting/greeting, request/grant</li> </ul>	Introduction Early Systems ELIZA How ELIZA works PARRY SHIFLU How Does Dialogue Work? Exect hot Parts Free Speech hot Parsonses Dialogue System Components ThiPs	<ul> <li>Utterances: don't exactly match up with sentences; may span over several turns; may have several utterances within one turn AGENT: Yeah yeah the um let me see here we've got you on American flight nine thirty eight CUSTOMER: Yep. AGENT: leaving on the twentieth of June out of Orange County John Wayne Airport at seven thirty p.m.</li> <li>CUSTOMER: Seven thirty. AGENT: and into uh San Fransisco at eight fifty seven.</li> </ul>	Introduction Early Systems ELIZA How ELIZA works How Does Dialogue Work? Bane Feets Groen Martins Speech Acts Pan Recognition Dialogue System Corponents Dialogue System Components TRIPS
Basic facts about dialogues (cont.)	22/75 Language and Computers Topic 6: Dialogue	Grounding	23/75 Language and Computers	H.P. Grice and Conversation	24/75 Language and Computers
<ul> <li>common ground: the set of things which both speakers believe to be true of the conversation.</li> <li>e.g. Part of classroom common ground is that we are at OSU in a linguistics class. Not part of the common ground is what I had for dinner last night.</li> <li>Gricean maxims: rules of conversation</li> </ul>	Introduction Early Systems LLZA How ELIZA How ELIZA works PARPY SHRDLU How Does Dialogue Work?  Bace Fees Critican Maxime Speech Acts Pain Recognition Decourse Structure Reference Corpora Modeling discourse Dialogue System Components Traips	<ul> <li>In order to establish common ground, speakers do various things:</li> <li>acknowledgments and backchannels = short utterance which indicates the utterance was heard and that the speaker should continue. That's a nice shirt. Mm-hmm.</li> <li>continued attention, completing speaker's utterance, and so on can also indicate acknowledgment</li> </ul>	Topic 6: Dialogue Systems Introduction Early Systems ELZA How ELZA works PARRY SHERUU How Does Dialogue Work? Base Feet Gricean Maxim Speech Arts Pian Recognition Dialogue System Components TRIPS	<ul> <li>People often speak "indirectly," but it's very clear what they mean. They obey what Grice (1975) referred to as the four <b>maxims</b> (rules) or conversation</li> <li>All based on the <b>cooperative principle</b> = speakers are both trying to contribute to the purposes of the conversation.</li> <li>Can use these to infer what a speaker is really getting at.</li> </ul>	Topic 6: Dialogue Systems Introduction Eury Systems EurA How EU2A works Part Barie Faits Corcean Maxime Speech Aris Para Recognition Discourse Structure Reference Corpora Modeling discourse Dialogue System Components Trans

Gricean maxim 1: Quantity	Language and Computers Topic 6: Dialogue Systems	Gricean maxim 2: Quality	Language and Computers Topic 6: Dialogue Systems	Gricean maxim 3: Relevance	Language and Computers Topic 6: Dialogu Systems
<ul> <li>Quantity: Be exactly as informative as is required.</li> <li>Make your contribution as informative as is required (for the current purposes of the exchange) How many pencils do you have? Two. → means exactly two (or would have said more)</li> <li>Do not make your contribution more informative than is required. (passing by somebody on the way to class) How's it going? It's complicated. Yesterday I was sick</li> </ul>	Introduction ELIZ ELIZ Have ELIZA works party SHRDLU How Does Dialogue Work? Basic Facis Diacoura Structure Recognition Diacoura Structure Reference Corpora Modeling discourse Dialogue System Components Tairies	<ul> <li>Quality: Try to make your contribution one that is true.</li> <li>Do not say what you believe to be false</li> <li>Do not say that for which you lack adequate evidence Do you know how to drive a stick-shift? Yes, I do. I've seen my dad do it many times.</li> </ul>	Introduction Ecarly Systems ELZA Have ELIZA horks PARPE How Does Dialogue Work? Bacta Fats Composed System Corpora Madeling discurse Dialogue System Components TRIPS	<ul> <li>Relevance: Be relevant. Is Gail dating anyone these days? Well, she goes to Cleveland every weekend.</li> </ul>	Introduction Early Systems EUZA Here EUZA antos NARTU Here EUZA antos NARTU Here EUZA antos NARTU Here EUZA Batar Farta Batar Farta Batar Farta Batar Farta Batar Farta Batar Farta Secon Acts Plan Recognition Discourse Sentane Reference Corpora Madeling discourse Dialogue System Components Trans
	28/75		29/75		30/7
Gricean maxim 4: Manner	Language and Computers Topic 6: Dialogue	Speech acts	Language and Computers Topic 6: Dialogue	Kinds of speech acts	Language and Computers Topic 6: Dialogu
<ul> <li>Manner: Be perspicuous (easy to understand).</li> <li>Avoid obscurity of expression</li> <li>Avoid ambiguity</li> <li>Be brief (avoid unnecessary prolixity)</li> <li>Be orderly</li> </ul>	Systems Introduction Early Systems LLZA How ELZA How ELZA How ELZA How ELZA How ELZA How Does Dialogue Work? Bace Facts Cropps Han Recognition Discourse Structure Reference Copps Modeling discourse Dialogue System Components TRIPS	<ul> <li>Utterances are equated with actions in a dialogue (Austin 1962)</li> <li>For example, there are performative verbs, as in these sentences: <ul> <li>I (hereby) christen this ship <i>The Swarthy</i>.</li> <li>I pronounce you man and wife.</li> <li>I second that motion.</li> <li>I bet you five dollars the Buckeyes will win the NCAA championship this year.</li> </ul> </li> </ul>	Systems Introduction Early Systems LLZA works SHELLI How Does Dialogue Work? Basir Fasts Gricean Asses Plan Recognion Discourse Structure Reference Corpora Modeling discourse Dialogue System Components TRIPS	<ul> <li>Searle 1975</li> <li>Assertives = assert that something is the case (suggest, boast, conclude)</li> <li>Directives = commmand; attempt to get the listener to do something (ask, order, request)</li> <li>Commissives = commit to some future course of action (promise, plan, vow)</li> <li>Expressives = express psychological state of the speaker about some situation (thank, apologize, welcome)</li> <li>Declarations = bring about a different state of the world merely by saying them (performatives)</li> </ul>	Systems Introduction Early Systems SucA HearLI2A ands HearLI2A ands HearLI2A ands Hearly Dess Dialogy Work? Bach Faris Grosen Adas Plan Recognition Discores Structure Reference Dialogue System Components Trans
	31/75		32/75		33/7
Indirect Speech Acts	Language and Computers Topic 6: Dialogue Systems	DAMSL	Language and Computers Topic 6: Dialogue Systems	Using DAMSL	Language and Computers Topic 6: Dialogu Systems
<ul> <li>Speech acts can be direct or indirect</li> <li>Direct: Form matches meaning. <ul> <li>e.g. Please take out the garbage. (declarative structure; declarative meaning)</li> </ul> </li> <li>Indirect: The form and the meaning are different. <ul> <li>e.g. The garbage isn't out yet. (declarative structure; imperative/directive meaning)</li> <li>Could you take out the garbage? (interrogative structure; imperative/request meaning)</li> </ul> </li> <li>How do we account for this with a computer?</li> </ul>	EuZA Early Systems EuZA How EUZA works MHDU How Does Dialogue Work? Basis Farts Gricean Maxims Pan Recognition Discourse Structure Recognition Discourse Structure Recognition Discourse Structure Recognition Discourse Structure Recognition Discourse Structure Recognition Discourse Structure Recognition Discourse Structure Recognition Components TRIPS	<ul> <li>We can try to define these speech acts and automatically figure out each utterance.</li> <li>So, people have marked up text with different labels for speech acts.</li> <li>DAMSL (Dialogue Act Markup in Several Layers) is a scheme of speech acts which people mark up texts with.</li> <li>forward-looking functions → question, request, etc., looking for a response</li> <li>backward-looking functions → answer, agreement, etc., providing a response</li> <li>(Note the resemblance to adjacency pairs.)</li> </ul>	Eury Systems EuZA Hore EUZA works Merror EUZA works Merror EUZA works Merror EUZA works Merror EUZA works How Doces Dialogue Work? Basis Fats Groeen Marines Seeen Merror Discourse Studture References Corpora Modeling discourse Dialogue System Components TRIPS	<ul> <li>Using the DAMSL scheme, people can train a system on it, and then attempt to mark a new text with these labels.</li> <li>People can also have a dialogue system keep track of the previous forward-looking function to know how to respond.</li> </ul>	Eidzi Systems Eidzi Herr Lizz wurks Herr Lizz wurks Herr Lizz wurks Herr Lizz wurks Herr Eidz wurks Herr Bauts Farts Grean Maxims Sterein Arts Discores Recognition Discores Recogni Discores Recognition Discores Recognit

Plan recognition	Language and Computers Topic 6: Dialogue Systems	Template	Language and Computers Topic 6: Dialogue Systems	Inferring Intention	Language and Computers Topic 6: Dialogue Systems
One thing a computer can do is to try to match what a speaker says with what it's looking for, i.e. a computer can be trying to fill a <b>template</b> , or <b>schema</b> e.g. If I call up a flight system, it knows that there is certain information which needs to be filled in: departure city, arrival city, dates of travel, etc.	Introduction Early Systems Early Work 200 Comparison Comparison Early Comparison Compari	<ul> <li>BOOK-FLIGHT(Customer, Flight): DEPARTURE-DATE(Flight) = ? DEPARTURE-TIME(Flight) = ? PAYMENT-METHOD(Customer) = ? NUMBER-OF-REQUESTED-SEATS = ? NUMBER-OF-OPEN-SEATS(Flight) = ? </li> <li>Effect: FLIGHT-BOOKED(Customer, Flight) = Yes?/No?</li> <li>So, when a customer says, <i>I want to leave Dallas on March 3</i>, the DEPARTURE-DATE and DEPARTURE-CITY both get filled in.</li> <li>Only when all of the template has been filled in is the flight acutally booked.</li> </ul>	Introduction Early Systems ELZA How ELIZA Work? SurRCU Bace Rade Yourk? Ba	Computers can try to infer what a user intended, or what a user is intending to do next. ⇒ Convert an indirect speech act into something a computer can use. <i>Can you give me a list of flights from Atlanta?</i> ⇒ If the user asks if I'm capable of doing something, it probably wants me to do that thing.	Introduction Early Systems How ElizZawas Swareu Wark? Banc Arat Sware Arat Sware Arat Danarea Bancometa Danarea Bancomet
Confirmation and repair strategies	Language and Computers Topic 6: Dialogue Systems	Discourse structure	Language and Computers Topic 6: Dialogue Systems	Subdialogues	Language and Computers Topic 6: Dialogue Systems
Sometimes the system will have to <b>confirm</b> what a user said. e.g. 'So you want to travel from Amsterdam to Utrecht?' (explicit) 'When do you want to travel from Amsterdam to Utrecht?' (implicit) (http://www.compuleer.nl/Nimes.html) Sometimes the system will have to account for a <b>repair</b> that the human made. e.g. I'd like to take the D Train, um, no, the A Train.	Introduction Early Systems ELZA How ELIZA works PARRY Surface Work? Bace Fails Groups Maxims Specif Acia Decorrse Switchere Reference Corpore Dialogue System Components TRIPS	<ul> <li>Discourse, or dialogue, has some structure to it—not just a bunch of random, loosely-connected statements.</li> <li>This is even more the case when the speakers are trying to achieve some purpose, or task, like giving directions or fixing a car → task-based dialogues</li> <li>Every discourse has a discourse purpose = a reason for talking (Grosz and Sidner 1986)</li> <li>The problem is trying to figure out the intentions of the speakers.</li> </ul>	Introduction Early Systems ELZA How ELIZA SHOPLING ELIZA How Does Dialogue Work? Basic Ficis Grocen Maxims Specia Acis Specia Acis Reference Corpora Modeling discortes Dialogue System Components TRIPS	<ul> <li>And within the overall dialogue, there are subdialogues</li> <li>e.g. in order to book a flight, you must ask me where I want to go.</li> <li>Or I may have to correct you in a subdialogue (<i>I said Columbus, not Columbia</i>)</li> </ul>	Introduction Early Systems EuX Howe EuX Awars Nerver Work? Baas Facts Grasse Means Speet Acts Speet Acts Speet Acts Speet Acts Speet Acts Des Receptor Par Acceptor Baases Reference Corpor Model geostems Dialogue System Components
Determining structure	40/75 Language and Computers Topic 6: Dialogue Systems	Reference	41/75 Language and Computers Topic 6: Dialogue Systems	Coreference	42/75 Language and Computers Topic 6: Dialogue Systems
<ul> <li>If we can figure out the discourse structure automatically, the computer is better able to keep track of what's going on.</li> <li>⇒ When you know the structure, you're better able to know what pronouns (and definite noun phrases) refer to.</li> <li>Determining structure is not always clear-cut, and humans can disagree as to the correct structure.</li> </ul>	Introduction ELIZA How ELIZA works PARIX Work? How Dees Dialogue Work? Basic Fasts Gricean Maxims Speech Aris Pana Recognition Dialogue System Dialogue System Tarihis	<ul> <li>We call what a word refers to its reference = using expressions to refer to things</li> <li>Indefinite noun phrases: new to the discourse, e.g. a book, some books</li> <li>Definite noun phrases: something identifiable to the listener, e.g. the book, those books</li> <li>Pronouns: replacement for a noun phrase, e.g. it, she, etc.</li> </ul>	Introduction Ecarly Systems ELCA How Clu2A works parsers SHOLU How Does Dialogue Work? Basic Facts Grosen Maxims Speech Acis Dialogue System Compon Modeling discurse Dialogue System Compon Taines	These different kinds of noun phrases can refer to the same thing, i.e. <b>coreference</b> I saw <b>a monkey</b> yesterday. <b>The dumb thing</b> was wily, and <b>it</b> kept throwing things at me. $\rightarrow$ <i>a monkey, the dumb thing</i> , and <i>it</i> all refer to the same real-world creature.	Introduction Early Systems ELA Here EL22 works Netron Here EL22 works Netron How Doors Dialogue Work? How Doors Dialogue Work? How Doors Dialogue System Acts Pion Recognition Dialogue System Components Trans

Preferences for Pronoun Reference	Language and Computers Topic 6: Dialogue Systems	Syntactic and Semantic Constraints	Language and Computers Topic 6: Dialogue Systems	Selectional restrictions	Language and Computers Topic 6: Dialogue Systems
We know they all co-refer, but how can a computer tell? How does it go about solving the task of <b>pronoun resolution</b> ? • Syntactic and Semantic Constraints • General Preferences/Heuristics The task is to find the previous noun phrase (NP) in the discourse which the current pronoun (or definite NP) refers to.	Introduction Early Systems EUZA How ELIZA works RARRY SHEOLU Basic Facts Grican Marine Speech Acts Plan Recognition Discourse Soruchine Recognition Discourse Soruchine Corpora Modeling discourse Dialogue System Components Traips	<ul> <li>Number, gender, and person agreement: co-referents must agree in all of these properties John has a new car. It/*They is red. (number) John has a new car. He (=John) is attractive. (gender) John and I have new cars. We/*They love these cars. (person)</li> <li>Syntactic constraints: reflexives (<i>himself</i>, <i>herself</i>,) generally refer to subject of sentence John bought him/himself a new car.</li> </ul>	Introduction Early Systems EuZ SwebLU How Does Dialogue Work? Basic Faits Grosen Maxims Speech Ads Diacours Structure Exercise Diacours Structure Dialogue System Components Tairis	<ul> <li>Selectional restrictions: verbs pick out what kinds of nouns they can have for subjects and objects.</li> <li>e.g. <i>drive</i> needs a human object and a drivable object. John parked his car in the garage. <i>He</i> had driven <i>it</i> around for a bit.</li> <li>Note that these restrictions can be extended: <i>The White House said yesterday</i></li> </ul>	Introduction Early Systems EuX Swebu How Dees Dialogu Work? Bair Fars Groen Maxins Speech Ats Pars Recognion Discours Braches Discours System Components Trans
	46/75		47/75		48/75
General Preferences/Heuristics	Language and Computers Topic 6: Dialogue Systems	General Preferences/Heuristics (cont.)	Language and Computers Topic 6: Dialogue Systems	Resolving Pronouns	Language and Computers Topic 6: Dialogue Systems
<ul> <li>After filtering out unwanted referents due to agreement and so on, we have various heuristics we can use to find the pronoun's referent.</li> <li>Recency: pronoun refers to most recent possible NP John bought a cookie, and I bought a cake. Mary ate it.</li> <li>Subject over Object: prefer matching the pronoun to a previous subject of a sentence over the sentence's pronoun. John hit Bill. Then I asked him to come with me.</li> </ul>	Introduction Early Systems ELZA How ELIZA works PARRY SHROLU How Does Dialogue Work? Basic Fasts Gricean Maxims Speech Acts Dialogue Structure Reference Components Trups	<ul> <li>Repeated mention: if someone keeps getting mentioned, they're more likely to be the referent of a pronoun.</li> <li>Parallelism: Back-to-back sentences with similar structures can help pick out the referent. Jim went with Carl to the supermarket. And I went with him to the gas station.</li> </ul>	Introduction Early Systems ELZA How ELIZA works PARRY SHRDU Basic Faits Groeen Maxims Speech Acts Discourse Structure Discourse Structure Corpora Modeling discourse Dialogue System Components Trains	<ul> <li>So, we can combine all this knowledge into a system for resolving pronouns.</li> <li>1. Take all nouns in a sentence and make a list of possible referents.</li> <li>2. Rank the nouns in terms of recency, frequency, subjecthood, and so on.</li> <li>3. In the next sentence, try to match the pronoun with something in that list, starting with the most probable.</li> <li>4. Rule out any "match" which violates agreement or other syntactic and semantic constraints</li> </ul>	Introduction Early Systems ELZA How ELIZA Work? Banc Parts Groen Maxims Speech Ards Speech Ards Para Recognition Decourse System Components Trains
How do we get our knowledge about how dialogue works?	49/75 Language and Computers Topic 6: Dialogue Systems	Human-human and human-computer interaction	50/75 Language and Computers Topic 6: Dialogue Systems	Natural dialogues	51/75 Language and Computers Topic 6: Dialogue Systems
Look at <b>human-human interaction</b> , i.e. how humans have interacted with computers Look at <b>human-computer interaction</b> , i.e. how humans have interacted with computers Also HH psycho-linguistic experiments (Jurafsky & Martin, 18.4 (p. 707-712))	Introduction Early Systems ELZA How ELZA works PARFU SHRDLU Back Facts Grocen Maxims System Arts Pan Boare Southers Plan Boare Southers Plan Boare Southers Dialogue System Components Dialogue System Components	<ul> <li>We look at corpora = large texts of collected data, often annotated with linguistic properties.</li> <li>e.g. A corpus of dialogues about giving directions from a map.</li> <li>Natural dialogues = A record of two (or more) humans speaking with one another, often about a task</li> <li>Wizard of Oz dialogues = A person talks to a "computer", which is actually a human (thus the WOZ analogy)</li> </ul>	Introduction Early Systems ELZA How ELIZA works PARRY SHRDU Basic Ficits Green Maxims Speech Acits Recompany Basics Ficits Charaen Maxims Speech Acits Diacourse Structure References Components TaiPis	<ul> <li>Pluses:</li> <li>Natural user tasks and needs</li> <li>Easy to set up and record</li> <li>Minuses:</li> <li>These record human-human interactions, not human-computer interactions</li> <li>⇒ People often speak differently to a computer, will often adapt to the way a computer is talking to them.</li> </ul>	Introduction Early Systems ELZA How ELIZA wirs warecu Work? Baar Fars Groen Marins Groen Marins Groen Marins Groen Marins Groen Marins Groen Marins Diacours Structure Retrocos Dialogue System Components Trans

Wizard of Oz dialogues	Language and Computers Topic 6: Dialogue Systems	Wizard of Oz dialogues: downside	Language and Computers Topic 6: Dialogue Systems	Modeling discourse	Language and Computers Topic 6: Dialogue Systems
<ul> <li>"Computer" is actually a human in disguise. Pluses:</li> <li>Provide insights on human-computer interaction (HCI) without having to set up a computer which is capable of HCI.</li> <li>Allow freedom in the range of tasks you can cover.</li> </ul>	Introduction Early Systems ELZA How ELIZA anois parry SHROLU How Does Dialogue Work? Basic Facts Grican Madres Speech Acts Plancourse System Diacourse System Components Traips	<ul> <li>Minuses:</li> <li>Often an artificial task</li> <li>Can take a lot of computing resources to set up</li> <li>Need wizards who can type fast, accurately, and in a rather stiff manner, if they are to emulate a computer</li> <li>May not get consistent behavior from the wizard across different attempts</li> </ul>	Introduction Early Systems ELZA How EUZA works How EUZA works How Does Dialogue Work? Batic Facts Grican Maxims Speech Acts Plan Recognition Diacours Structure Reference Components Dialogue System Components Trues	Now that we know how dialogue works, we want to know how to model it, what kind of <b>architecture</b> it will have. ⇒ depends on what we want to do. • State transition networks • Frame-based systems	Introduction Early Systems ELZA How ELIZA ands PARPUL How Does Dialogg Work? Baaic Faras Grosen Maxims Speech Acts Pan Recognism Discoras Structure Discoras Structure Theorem Structure Discoras Structure
State transition networks	55/75	Finite-state automata	56/75 Language and	FSAs continued	57/7 Language and
<ul> <li>Well-structured dialogue can be modeled with a state transition network.</li> <li>e.g. Dialogue system where the user only has to answer questions → very constrained</li> <li>State 1: I know nothing, so I need to ask for the user's name.</li> <li>If the user gives me a name, go to State 2</li> <li>If the user does not give me a name, go back to State 1</li> <li>State 2: I know the user's name, so I ask for the user's birthday.</li> <li>If a birthday is given, go to State 3.</li> <li>If a non-birthday is given, go to State 2.</li> <li>If the user claims their name was wrong, go back to State 1.</li> </ul>	Computers Topic 6: Dialogue Systems Introduction Early Systems ELZA How ELZA works PARPU Work? Basic Facts Gricean Maxims Speech Acts Plan Recognition Dialogue System Dialogue System Dialogue System Components Trains	<ul> <li>A state transition network is basically just a finite-state automaton (FSA) = network of states and transitions between states. (Also called a finite-state machine.)</li> <li>By moving through the FSA, you try to match an input string.</li> <li>The idea is that you can move from state to state, when conditions on the arcs are met.</li> <li>e.g. Move from state 0 to state 1 if I encounter the letter c. (Otherwise, do nothing.)</li> </ul>	Computers Topic 6: Dialogue Systems EuZa How ELIZa works Parry Skribluu How Does Dialogue Work? Basic Faits Groeen Maxims Speech Arits Parr Recognition Dialogue System Components Trains	We represent states with <b>nodes</b> (circles) and transitions with <b>arcs</b> (arrows) in a picture. (Note that the numbers on the nodes are just for our convenience; they don't really "mean" anything.) $\underbrace{\begin{array}{c} c \\ 0 \\ \hline 0 \\ \hline \end{array}} \underbrace{\begin{array}{c} c \\ 0 \\ \hline \end{array}} \underbrace{\begin{array}{c} 0 \\ \hline 0 \\ \hline \end{array}} \underbrace{\begin{array}{c} 1 \\ \hline 0 \\ \hline \end{array}} \underbrace{\begin{array}{c} 0 \\ \hline \end{array}} \underbrace{\begin{array}{c} 1 \\ \hline 0 \\ \hline \end{array}} \underbrace{\begin{array}{c} 0 \\ \hline \end{array}} \underbrace{\begin{array}{c} 1 \\ \hline \end{array}} \underbrace{\begin{array}{c} 0 \\ \hline \end{array}} \underbrace{\begin{array}{c} 0 \\ \hline \end{array}} \underbrace{\begin{array}{c} 1 \\ \hline \end{array}} \underbrace{\begin{array}{c} 0 \\ \hline \end{array}} \underbrace{\begin{array}{c} 0 \\ \hline \end{array}} \underbrace{\begin{array}{c} 1 \\ \hline \end{array}} \underbrace{\begin{array}{c} 0 \\ \hline \end{array}} \underbrace{\begin{array}{c} 0 \\ \hline \end{array}} \underbrace{\begin{array}{c} 1 \\ \hline \end{array}} \underbrace{\begin{array}{c} 0 \\ \hline \end{array}} \underbrace{\begin{array}{c} 0 \\ \hline \end{array}} \underbrace{\begin{array}{c} 1 \\ \hline \end{array}} \underbrace{\begin{array}{c} 0 \\ \hline \end{array}} \underbrace{\begin{array}{c} 0 \\ \hline \end{array}} \underbrace{\begin{array}{c} 1 \\ \hline \end{array}} \underbrace{\begin{array}{c} 0 \end{array}} \underbrace{\begin{array}{c} 0 \\ \hline \end{array}} \underbrace{\begin{array}{c} 0 \end{array}} \underbrace{\end{array}} \underbrace{\begin{array}{c} 0 \end{array}} \underbrace{\begin{array}{c} 0 \end{array}} \underbrace{\begin{array}{c} 0 \end{array}} \underbrace{\begin{array}{c} 0 \end{array}} \underbrace{\end{array}} \underbrace{\end{array}} \underbrace{\begin{array}{c} 0 \end{array}} \underbrace{\end{array}} \underbrace{\end{array}} \underbrace{\begin{array}{c} 0 \end{array}} \underbrace{\end{array}} \underbrace{\end{array}} \underbrace{\end{array} \\ \underbrace{\end{array}} \underbrace{\end{array}} \underbrace{\end{array} \end{array} \underbrace{\end{array}} \underbrace{\end{array} \underbrace{\end{array}} \underbrace{\end{array} \end{array} \underbrace{\end{array} \underbrace{\end{array}} \underbrace{\end{array}}$	Computers Topic 6: Dialogu Systems EuZA How EUZA How Does Dialogu Work? Baic Rats Groan Maxims Speech Ads Pan Recognition Dialogue System Dialogue System Dialogue System Trans
FSAs continued	58/75 Language and Computers Topic 6: Dialogue	Drawing FSAs	59/75 Language and Computers Topic 6: Dialogue	Frame-based systems	60/7 Language and Computers Topic 6: Dialogue
What do the following FSAs do? $\begin{array}{c} & & & \\ & & & \\ & & & \\ \end{array}$ $\begin{array}{c} & & & \\ & & & \\ \end{array}$ $\begin{array}{c} & & & \\ & & & \\ \end{array}$ $\begin{array}{c} & & & \\ & & \\ \end{array}$ This corresponds to the regular expression: colou*r $\begin{array}{c} & & & \\ & & & \\ \end{array}$ $\begin{array}{c} & & & \\ & & \\ \end{array}$	Systems Introduction Early Systems ELZA works Parter SweELZA works Parter Work? Basic Facts Grocean Meaning System Action Parter Bacogration Decognition Parter Components Trups	<ul> <li>Things to remember:</li> <li>You have to have a single start node, but you can have more than one end node.</li> <li>The nodes don't necessarily have to go in order from left to right.</li> <li>FSAs are what are used to match regular expressions. Logically, they are equivalent.</li> </ul>	Systems Introduction Early Systems ELZA ELZA ELZA ELZA ELZA ELZA ELZA ELZA	<pre>Dialogues with a little more complexity—e.g. the user can ask questions, too—can be modeled with frame-based systems = systems based on frames, or templates. We saw these earlier: BOOK-FLIGHT(Customer, Flight): DEPARTURE-DATE(Flight) = ? DEPARTURE-TIME(Flight) = ? PAYMENT-METHOD(Customer) = ? NUMBER-OF-REQUESTED-SEATS = ? NUMBER-OF-OPEN-SEATS(Flight) = ? </pre>	Systems Introduction Early Systems ELIZA ELIZA sorts EXERCISA EXER
This corresponds to the regular expression: (ab cb+)				Effect: FLIGHT-BOOKED(Customer, Flight) = Yes?/No?	

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Components of a dialogue system	Language and Computers Topic 6: Dialogue Systems		Language and Computers Topic 6: Dialogue Systems	Interface (media/mode)	Language and Computers Topic 6: Dialogue Systems
<ul> <li>Interface (media/mode)</li> <li>Discourse manager</li> <li>Context manager</li> <li>User model</li> <li>Knowledge sources</li> <li>Language Interpreter &amp; Generator</li> </ul>	Introduction Early Systems ELZA How ELZA works PARTU How Does Dialogue Work? Basic Faris Grosen Maxims Speech Aris Diacours Structure Diacours Str	MALINImage: state st	Introduction Early Systems ELZA How ELZA works Parkiv SHOLU How Does Dialogue Work? Basic Fots Grican Maxims Speech Arts PlancaresSitution	If it's a spoken dialogue system, need an automatic speech recognizer. If it's a written dialogue system, simply need a keyboard. Can also consider the aesthetics of the system, if someone is communicating with a talking picture on a computer screen, for instance.	Introduction Early Systems ELZA How EL2A awns Pariv SHRUU How Dees Dialogue Work? Basic Fats Gracan Maxims Sapech Acts Plan Recognition Discourse Shruture Reference Corpora Modeling discourse Dialogue System Components Trains
Discourse manager	64/75 Language and Computers Topic 6: Dialogue	Context manager	65/75 Language and Computers Topic 6: Dialogue	User model	66/75 Language and Computers Topic 6: Dialogue
<ul> <li>a.k.a. Dialogue manager</li> <li>Decide whose turn it is</li> <li>Decide what items need attention</li> <li>Feed input and output to the linguistic systems.</li> </ul>	Systems Introduction Early Systems LUZA actual How ELZA actual How ELZA actual How Does Dialogue Work? Basic Fasts Gricean Maxims Speech Acts Plan Reception Discourse Structure Reference Corpon Modeling discurse Dialogue System Components TRUPS	<ul> <li>Pay attention to the surrounding context:</li> <li>What time it is</li> <li>Where the user is, what the conditions are there</li> <li>If the user is looking at something (e.g. a map), what does that map look like?</li> </ul>	Systems Introduction Early Systems ELZA Hore ELZA works RARRY SHROLU HOD Cose Dialogue Work? Basic Fords Gricean Maxims Speech Artis Plan Recognition Discourse Structure Reference Corpora Modeling discourse Dialogue System Components TRIPS	<ul> <li>Who is the user? What is the user thinking?</li> <li>Try to deduce various facets of the user:</li> <li>Beliefs = what do they believe to be true about this conversation?</li> <li>Intentions = what are they trying to do?</li> <li>Capabilities = what are they capable of doing?</li> </ul>	Systems Introduction Early Systems ELIZA How ELIZA works PARTY SHIPLU How Does Dialogue Work? Basic Fasts Grican Madins Speech Als Pan Recognition Discourse Studure Retermen Corpore Meding discourse Dialogue System Components
<ul> <li>Keep track of knowledge about the world the system might need</li> <li>If the user is looking at something (e.g. a map), what does that map look like?</li> <li>A database of flights: what flights are being offered by this airline?</li> <li>A listing of road closings</li> </ul>	Carry 5	And of course, we need to convert what the user says into some form of meaning representation (natural language understander). And we need to convert the system's (meaning) response into some form of language (natural language generator) A great deal of knowledge about how sounds, words, and sentences are formed is needed.	ABY75 Language and Computers Day Systems Introduction Larly Systems More Law More La	Swedish Dialogue System	69/75 Language and Computers Topics (Jalogue Systems) Introduction Early Systems ELZA How ELZA works Parry SHRUU More Dos Dialogue Work? Barls farls Grants farls Grants farls Grants farls Grants farls Grants farls The State The State Comparison Comparis
	70/75		71/75		72/75

