IAT 888: Metacreation
Machines endowed with creative behavior

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SFU

Assignments: for this week

- Submit a proposal for the theoretical research:
  - The proposal (1 page) should:
    - Name the Metacreation or the technical content you will focus on
    - Name the tools used
    - Include the proper bibliographic references (send me the PDF/scanned texts or links if available)
  - Let's talk about the scheduling of the presentations

Technical Topics (and possible topics)

- General AI:
  - Knowledge Representation
  - Expert systems, Search algorithms, CSP, ...
  - Autonomous agents:
    - Reactive agents: subsumption architecture
    - Cognitive agents: decision theoretic agents, BDI agents, coherentist approaches
    - Hybrid agent architectures
  - Multi-agent systems:
    - Agent communication (SAT, protocols, negotiation, argumentation)
    - Emergence: Ant systems, AMAS theory
- Machines learning:
  - Statistical learning, HMM, Reinforcement learning
  - Multi-agent learning (MDP, POMDP)
- A-life:
  - Evolutionary computing:
    - Genetic algorithms
    - Genetic programing
  - Swarm intelligence (flocks, ...)
  - Cellular automata, Simulation (MMAS)

List of metacreations

On the course web page:

1. Bob (Belinda Thom, Carnegy Melon University) – Sound - Agent/Unsupervised learning
2. Kinetic Engine (Arne Engelfeld, SFU, Vancouver) – Sound - MAS
3. VMMAS (Whulfhorst, UFRGS, Rio) – sound - MAS
4. Virtualatin (David Murray-Rust, University of Edinburgh) – sound - Agent/MAS
5. ANDANTE (Leo Ueda, University of Sao Paolo) - sound - Agent
6. Eden (Mc Cormack, CEMA, Melbourne) – visual - MAS/A-life
7. Continuator (Francois Pachet,, Sony lab Paris) – sound - HMM
8. O-MAX Brothers (Assayag, Ircam, Paris) – sound - statistical learning + MAS
9. CONCERT (Mozert, University of Colorado) – sound - neural network
10. CBR (Lewis, New York Technology Institute) – neural network
11. Chaosynth and CAMUS (Eduardo Miranda, Plymouth) – sound - cellular automata
12. GenJam (John Biles, Rochester Institute of Technology) - sound – genetic algorithm
13. Genetic images (Karl Sim, GenArts, Cambridge) – visual - genetic algorithm
14. Electric Sheeps (Scott Draves , Dreamworks, San Fransisco), - visual - genetic algorithm and fractals
15. Iconica (Troy Innocent, CEMA, Melbourne) – visual - A-life
16. Various Works (Christa Sommerer & Laurent Mignonneau Art) - visual - A-life
17. An interactive MIDI accompanist. (Toiviainen, P.) - sound - agent
18. SPAA or AALIVENET (Michael Spicer, Singapore*)* – sound - agent based
19. AARON (Harold Cohen) – visual - Expert System

Assignments: for this week

- **Readings:**
  - Guillaume Hutzler, Bernard Gortais, Alexis Drogoul, The Garden of Chance: A Visual Ecosystem, Leonardo, April 2000, Vol. 33, No. 2, Pages 101-106. (Available online through SFU library)
  - Yannis Labrou, Tim Finin and Yun Peng. Agent Communication Languages: The Current Landscape, Intelligent Systems, Vol. 14, No. 2, March/April 1999, IEEE Computer Society. (Available online trough SFU library and on the author's web page)
  - David Murray-Rust, Alan Smaill, Michael Edwards: MAMA: An Architecture for Interactive Musical Agents. Proceedings of the European Conference on Artificial Intelligence (ECAI), 2006, pages 36-40 (Available online)
  - David Murray-Rust, Alan Smaill, Musical Acts and Musical Agents, Proceedings of the 5th MUSICNETWORK Open Workshop, 2005. (Available online on the Workshop web page)

In-class discussion: readings

- Guillaume Hutzler, Bernard Gortais, Alexis Drogoul, The Garden of Chance: A Visual Ecosystem, Leonardo, April 2000, Vol. 33, No. 2, Pages 101-106. (Available online through SFU library)

- Quick presentation of the authors
- Analysis of the work:
  - What type of agents are they using?
  - What are the percepts that the agents gets?
  - What are the actuators?
  - What type of multiagent system is it?
- For next week, we will read another paper about this work which presents a validation.

In-class discussion: readings

- Yannis Labrou, Tim Finin and Yun Peng. Agent Communication Languages: The Current Landscape, Intelligent Systems, Vol. 14, No. 2, March/April 1999, IEEE Computer Society. (Available online trough SFU library and on the author's web page)
  - Presents agent communication languages (our topic today)
  - Seminal paper by the creators of KQML

In-class discussion: readings

- David Murray-Rust, Alan Smaill, Michael Edwards: MAMA: An Architecture for Interactive Musical Agents. Proceedings of the European Conference on Artificial Intelligence (ECAI), 2006, pages 36-40 (Available online)
- David Murray-Rust, Alan Smaill, Musical Acts and Musical Agents, Proceedings of the 5th MUSICNETWORK Open Workshop, 2005. (Available online on the Workshop's web page)
  - Research student, lecturer at the University of Edinburgh.
  - Uses some of the concepts presented today
  - Note that artificial agents can do several things in parralel. For example they can play music and communicate (conversation) at the same time.

"We read to know we are not alone."
C.S. Lewis

So far, … so good

- So far we went through:
  - Introduction to metacreation
  - Elements on creativity
  - Autonomous agents (Part 1):
    - Introduction to agents
    - Cognitive agents: the BDI model
- Today, we will focus on:
  - Elements of theories of communication
  - Agent communication

Elements of Theories of Communication

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What is meaning?

- The communication of meaning is both the main purpose and function of human language.
- Human communication: linguistic and extra-linguistic (often at the same time!)

⇒ We will only address linguistic communication

- In the context of human communication:
  - What is meaning? What are the different types of meaning?
  - Can we develop a scientific theory of meaning?
- In the context of machines communication:
  - How to explicitly represent meaning (a data structure, a process, …)?
  - How to represent meaning in ways that can be manipulated by computers in the context of Artificial Intelligence?

Scope: too much to say!

- Semiotic
- Semantics vs. pragmatics.
- Meaning in language vs. Meaning expressed by language.
- Linguistic meaning vs. speaker meaning.
- Types of meaning (social vs. grammatical vs. lexical/descriptive meaning.
- Denotational/descriptive & connotational meaning.
- Sentence/word meaning.
- Meaningfulness & informativeness.
- Grammaticality & acceptability.
- Direct/indirect referential theory of meaning
- Behaviouristic theory of meaning.
- *Meaning-is-the-use* theory.
- Sense vs. reference vs. denotation
- Coreference and deixis
- Sense relations: syntagmatic and paradigmatic.
- Types of reference (definite/indefinite, specific, etc.)
- Variable/constant reference
- Referring/non-referring expressions.
- Generics and reference.
- Sentences vs. utterances vs. proposition

Can we develop a scientific theory of meaning?

- A number of researchers have worked on that!
  - Semantics (part of linguistics):
    - Defined as the science of meaning
    - Related to *sêma* 'sign'
    - The subject itself discussed in the works of antique philosophers (Plato and Aristotle)
    - The term is not used till the 20th century
    - Michel Jules Alfred Bréal (1832- 1925):
      - Regarded as a founder of modern semantics
      - Coined the French word "sémantique" (1893) from the Greek *semantikós,* "having meaning"
      - In 1900, Breal's book: "*SEMANTICS:* Studies in the Science of Meaning"

Scientific theories of meaning

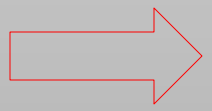
- **Semantics**: science of meaning
- **Semiotics**: science of signs, sign systems and their use
- **Pragmatics**: science of the use of language (meaning in context)
- Psychological theories, exhausted by notions of thought, intention, or understanding
- Philosophy of mind
- Semasiology: analysis of the relation between form and content, semantic changes.

Outline of the presentation

- Introduction
- Referential theories of meaning
- Truth conditional theories
- Meaning as usage:
  - Speech Act Theory
  - Grice Maxims
- Applications in AI
- Conclusion

Referencial theories: Semiotics

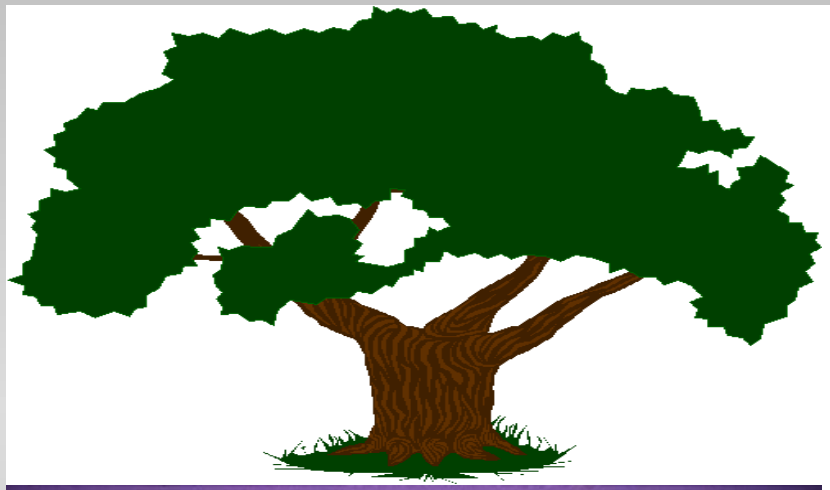
- The AAA framework (Aristotle, Augustine, and Aquinas):
  - **Meaning** is a relationship between two sorts of things: signs and the kinds of things they mean (intend, express or signify)
  - One term in the relation of meaning necessarily causes something else to come to the mind in consequence.
  - In other words: a **sign** is defined as an entity that indicates another entity to some agent for some purpose.



Referencial theory of meaning

Semiotics

- Different types of signs (same reference)

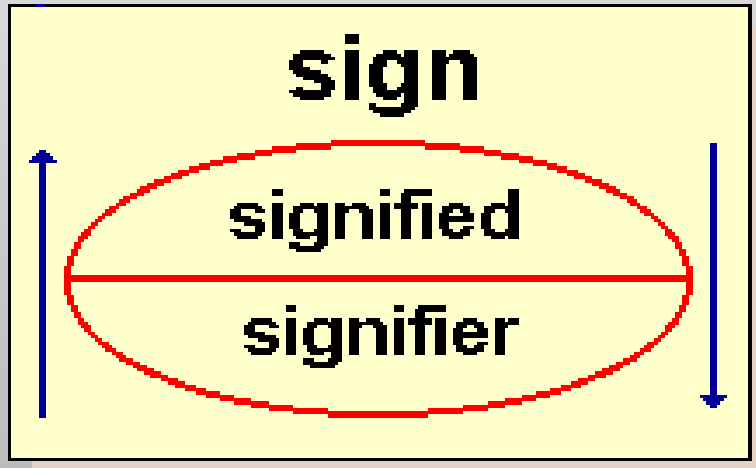


Tree

Semiotics

- Initiated by Saussure and Pierce, ...
- More general than linguistic
- Thus less specific

Table



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The meaning in linguistic: semantics

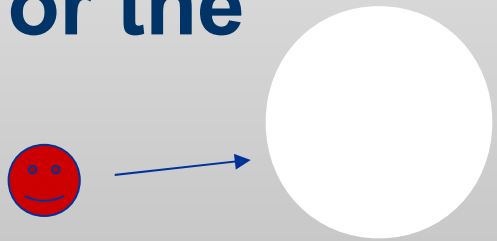
Meaning is usually defined in terms of truth conditions

- **Meaning is compositional: the meaning of an expression is a function of the meaning of its parts and the way they are put together.**
- **Logic tools offer good models of truth-conditional (vericonditional) semantics.**

The Process of Understanding

1. **Resolve references:**
   - Endophora (intra-linguisit, i.e. in the same text), *"I saw Sally yesterday. She was lying on the beach"*
   - Exophora (extra-linguistic). *"The queen"* in the UK
2. **Transform the sentence (linguistic forms) into a proposition (logical forms),**
3. **Imagine what would it take for the proposition to be true**

- *S: I have been to the moon.*
- *P: Gone(Philippe, Moon)*



- **Truth conditions, not truth value**

Truth conditional semantics

- Long tradition of philosophers: Aristotle, Frege, Russel, Tarsky, Kripke, Wittgenstein
- Truth conditional semantics have been considerably developed with the emergence of modal logics.
- The most popular and rigorous formulations in modern semantics is called Montague Grammar
- Truth theories of meaning have been critisised in many ways: they account only for literal meaning of statements.

Critics of Truth Conditional Semantics

- Not every utterances are statements:
  - « Can you pass me the salt? »
  - Some expression do not have any truth conditional meaning: « Hello »
- Literal meaning vs, non-literal meaning.
  - « Can you pass me the salt? »
  - Literal meaning: closed (Yes/No) question
  - Non-literal meaning: request
- Speaker meaning vs. Semantic meaning: what is intended by the speaker vs. what is meant by the language
  - There's the door!

Semantics vs. Pragmatics

- The distinction between literal meaning and non-literal meaning and speaker meaning vs semantic meaning is a good introduction for the distinction between semantics and pragmatics:
  - Semantics: meaning out of context
  - Pragmatics: meaning that depend on the context and use of the utterance.
- Use and meaning: the meaning of a word is its use in language (Wittgenstein).
  - Meaning is context dependant (we will get back to that).
  - « Hello » is used for greeting, « Sorry » for apologising, ... these words stands for (symbolic) actions (but that correspond to physical ones)

Outline of the presentation

- Introduction
- Referential theories of meaning
- Truth conditional theories
- Meaning as usage (language as action):
  - Speech Act Theory (SAT)
  - Grice maxims
- Applications in AI
- Conclusion

From semantics to pragmatics

- The history of linguistics and the philosophy of language has focussed on factual assertions, and the other uses of language tended to be ignored
- We use language to do things:
  - Statement (You are on time),
  - Order (Be on time!),
  - Promise (I will be on time),
  - Questions (Are you on time?),
  - Requests (Can you be on time?), ...

Speech Act Theory (SAT)

- Main idea of SAT is that using language is an action (like the others)
- Those actions are called speech acts.
- Speech act theory is the result of a long tradition in analytic philosophy of language:
  - Wittgenstein (1953, Philosophical Investigations)
  - Grice (1957, Meaning)
  - Austin (1962, *How to do things with Words* based on Harvard lectures, 1955)
  - Searle (1969, Speech acts)
  - Vandervecken (1990, Meaning and speech acts)
- The study of speech act is part of pragmatics

Speech Act Theory (SAT)

- For each *primitive* speech act, four dimensions may be discriminated:
  - Utterance act: the physical utterance of a message by the speaker;
  - Locutionary act: the expression and perception of a propositional content (e.g. it's raining, es regnet, il pleut);
  - Illocutionary act: the inference of the intended interpretation of an utterance (e.g. Can you pass me the salt?);
  - Perlocutionary act: the expected result of an utterance in the context/world. E.g. Change some mental states of the locutor, provoque an action, …

The F(P) framework

- **The illocutionary act can be regarded as the application of an illocutionary force F on the propositional/declarative content P: F(P).**
- **The six components of the illocutionary force :**

1. **Illocutionary point:**
   - **Assertive**: the speaker expresses his world representation (inform, assert…);
   - **Directive**: the speaker commits others (order, ask…);
   - **Commissive**: the speaker commits himself (promise);
   - **Expressive**: the speaker expresses his feelings (love declaration…);
   - **Declarative**: the speaker acts on the context (firing, blessing, marrying, ...).

The F(P) framework

- The illocutionary point is the main component because it indicates the direction of fit of the act:
  1. From words to the world (assertive)
  2. From the world to the words (directive, commissive)
  3. Double direction (declaratif)
  4. Empty direction (expressif)
- But there are 5 others dimensions to an illocutionary force

The F(P) framework:

Five other components:

- **Mode of achievement**: specify ways of achieving illocutionary forces (adverbs);
- **Propositional content conditions**: depending on the illocutionary force, there are conditions restricting the propositional content (e.g. promise of a futur action);
- **Preparatory conditions**: conditions the speaker has to fullfill before achieving the illocutionary force (e.g. beliefs about feasability) ;
- **Sincerity conditions**: specify conditions on the speaker ’s mental states for a syncere illocutionary act (e.g. promise);
- **Degree of strength**: specify the illocutionary force ’s intensity (e.g. imploring is stronger then asking).

Felicity Conditions

- For each primitive speech act, four dimensions may be discriminated:
  - utterance act: the physical utterance of a message by the speaker;
  - locutionary act: the expression and perception of a propositional content;
  - illocutionary act: the intended interpretation of an utterance;
  - perlocutionary act: the expected result of an utterance in the context/world.

Success

Satisfaction

  - *E.g.: It 's sunny*
  - *E.g.: Eat your spinash!*

Speech act are not true or false, they succeed of fail!

Implicit illocutionary points

- **Speech act theory is very systematic:**
  - **Illocutionary points can be identified according to performative verbs…many classifications**
  - **Implicit performatives can be rephrased with explicit ones:**

I'll be there

→ **I** promise **I'll be there**

Drop by if you're ever in the neighbourhood

→ **I** invite **you to drop by if you're in the neighbourhood**

Ten pounds says that you don't last an hour

→ **I** bet **ten pounds that you don't last an hour**

Blair is the Prime Minister

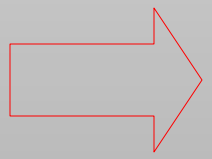
→ **I** state/assert **that Blair is the Prime Minister**

The festival is open

→ **I declare that the festival open**

Complex illocutionary acts

- **Illocutionary force can be:**
  - **Iterated and embedded: F(…F(p)…)**
    - **E.g. You can assert that a promise has been made, …**
    - *He promised to do his best*
    - **I assert (he promised(to do his best))**
  - **Composed: $F_1(p_1)$ & $F_2(p_2)$**
    - *He promised to do his best and he left.*



We are not limited to declarative use of language anymore, we can represent the various speech acts (as they occur in dialogues,...).

Indirect speech acts

- When the sentence type and speech act 'match': a direct speech act
- But not all speech acts are direct:

1. *There's the door.*
2. *Would you mind handing me the salt?*
3. *Leave me, then* (*and I'll jump in the river*).

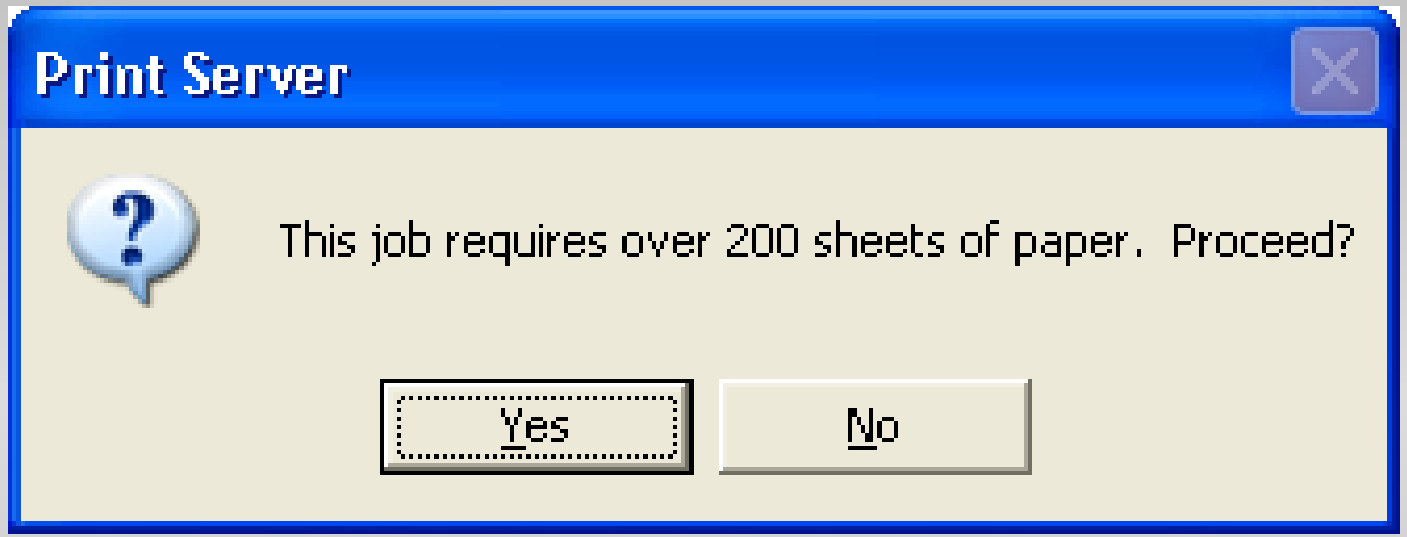
	DIRECT	INDIRECT
1.	Statement	Order
2.	Question	Request (for action)
3.	Order/Statement	Threat (assertion)

Windows message boxes

Direct speech act: **Statement of fact and request for acknowledgment.**

User must infer: **Go and pick up the printout.**

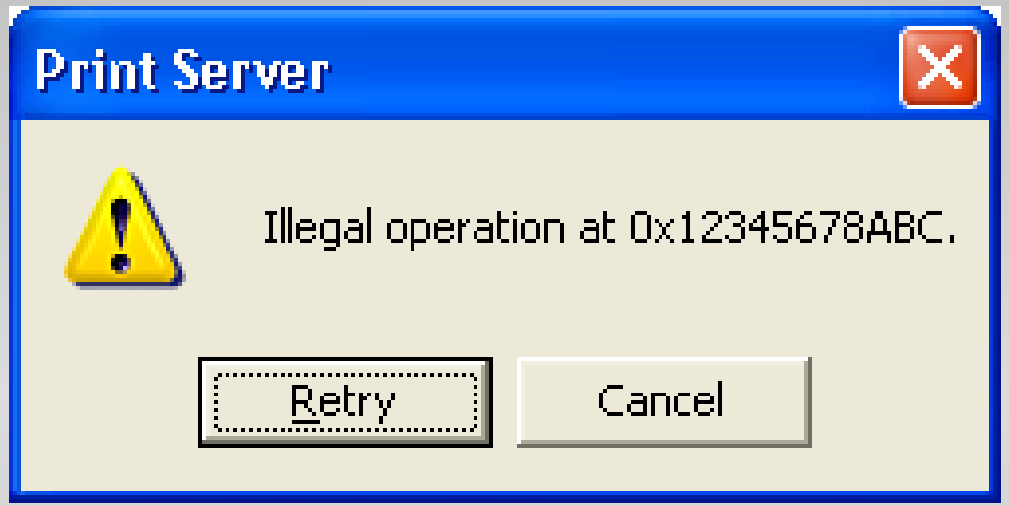
Windows message boxes



Direct speech act: Yes/no question.

User must figure out what the answer should be.
User must answer truthfully.

Windows message boxes



Direct speech act: **Statement of fact.**
Cryptic request for reply.

User must infer: **what on earth this means!**

Indirect speech acts

- **How do we recognise and interpret indirect speech acts?**
- **i.e. what makes an indirect speech act felicitous?**

Searle's explanation: the literal meaning of the utterance must address (point at) one of the felicity conditions of the indirect speech act in question

Indirect speech acts

- **E.g. recognising and interpreting an indirect request:**

Can you pass the salt?

Searle's conditions for requests:

[*S*=speaker, *H*=hearer, *A*=future action]

- Preparatory: ***H* is able to perform *A*.**
- Propositional: ***S* predicates a future act *A* of *H*.**
- Sincerity: ***S* wants *H* to do *A***
- …

The literal meaning addresses the preparatory conditions of the indirect speech act.

Indirect speech acts

- **But the literal meaning may not be the whole story…**
- **There is an idiomatic (whose meaning is not compositional) element in some indirect speech acts**
- **Though the literal meaning still seems to be accessible**
  - *May I ask you what time is it?*
  - ***Yes**, it's ten pass two.*

Why indirect speech acts?

One common reason: politeness

- *May I ask you the time?* (speaker-action)
- *Could you tell me the time?* (hearer-action)

Why politeness? May be for face-saving?

The indirectness diminishes the threat of orders, request, …)

- Please, open the window,
- *It's very hot in here*
- *Would you mind opening the window?*

(NB. may be highly culture-specific)

Speech Act Theory (SAT)

- Very expressive theory (can you find a counter examples?)
- Validated in 27 languages (ongoing process)
- Quite formal and systematic
- Used a lot in HCI, NLP and AI with quite impressive results
- A vibrant research community (linguistics, philosophy of language, computer science, social sciences, e.g. Sociolinguistics, ...)

What is said and what is meant

What is said is rarely what is meant

1. *A: Has Bill got a girlfriend?*
   B: He's been making a lot of trips to Glasgow lately.
   [usually conveys: 'B believes that Bill has a girlfriend.']
2. *A: I've run out of petrol.*
   B: There's a garage just round the corner.
   [usually conveys: 'You can get petrol there; it's open for business, etc.']
3. *I've read some of those books.*
   [usually conveys: 'I haven't read them all.']

What is said..... and what is meant

- Not always the same
- In fact, what is said is rarely all that is meant
  - the *reasons* why we say what we say matter
  - the *implications* of what we say matter
  - what we say is often ambiguous, over-general or uninformative, out of particular contexts.
- So understanding utterances involves much more than 'decoding' the language used

Pragmatics

Semantics **≈ what linguistic expressions mean out of context (≈ truth conditions)**

Pragmatics **= how meaning arises from the interaction of linguistic meaning with contextual factors:**

- **the physical situation**
- **general 'world knowledge'**
- **the speaker's apparent intentions, ...**

Implicatures

H.P. Grice coined the term implicature for communicated non-truth-conditional meaning:

- **Conventional implicature is non-truth-conditional meaning associated with a particular linguistic expression**
  E.g.: *The use of but to generate contrast,…*
- **A conversational implicature is not intrinsically associated with any expression. It is inferred from the use of some utterance in context**

Conversational implicatures

Conversational implicature is inferred meaning, triggered by what is actually said

Bill's been making a lot of trips to Glasgow lately.

What is said : 'Bill has been making a lot of trips to Glasgow lately'

What is implicated : 'The speaker believes that Bill may have a girlfriend in Glasgow'

Properties of implicatures

- **Context-dependent**: different implicatures arise in different contexts, even if an identical utterance is produced

A: *Has Bill got a girlfriend?*
B: *He's been making a lot of trips to Glasgow lately.*

A: *Has Bill started his Christmas shopping yet?*
B: *He's been making a lot of trips to Glasgow lately.*

A: *I've run out of petrol.*
B: *There's a garage just round the corner.*

A: *Damn; it's midnight and I'm starving.*
B: *There's a garage just round the corner.*

Properties of implicatures

- **Cancellable (or *defeasible*):**

A: ***Has Bill got a girlfriend?***
B: ***He's been making a lot of trips to Glasgow lately***
- still, I haven't heard anything, so probably not.

I've read some of those books
- In fact, unlike you, I've read them all.

A: ***I've run out of petrol.***
B: ***There's a garage just round the corner***
- I believe they've run out of petrol, but they might be able to call someone who could help.

Properties of implicatures

- **Non-detachable** (usually). *i.e.* you don't loose the implicature by substituting synonyms:

  A: *Has Bill got a girlfriend?*
  B: *He's been making a lot of trips to Glasgow lately.*
  B: *He's been a regular visitor to the Strathclyde area recently*.

  A: I've read some of those books.
  A: I've completed a number of those tomes.

  A: *I've run out of petrol.*
  B: *There's a garage just round the corner.*
  B: *You'll find a filling station just beyond that bend.*

Properties of implicatures

- **But note that certain implicatures *are* detachable (because they depend on the manner in which the utterance is phrased):**

  She produced a series of sounds that roughly corresponded to the score of* Home Sweet Home*.

  versus

  She sang* Home Sweet Home*.

Properties of implicatures

- Conversational implicatures should be *calculable* from the meaning of what is said plus identifiable aspects of the context
- How?

Grice's theory of implicature

Grice: conversational implicatures arise because we tend to be *co-operative*

- **The Co-operative Principle**:

" Make your conversational contribution such as is required, at the stage at which it occurs, by the accepted purpose or direction of the talk exchange in which you are engaged."

More specifically, follow certain conversational *maxims…*

The maxims of Quantity

1. Make your contribution as informative as is required (for the current purposes of the exchange).
2. Do not make your contribution more informative than is required.

The maxims of Quality

Supermaxim: Try to make your contribution one that is true.

1. **Do not say what you believe to be false.**
2. **Do not say that for which you lack evidence.**

The maxim of Relation

Be relevant.

The maxims of Manner

Supermaxim: Be perspicuous.

1. **Avoid obscurity of expression.**
2. **Avoid ambiguity.**
3. **Be brief (avoid unnecessary prolixity).**
4. **Be orderly.**

Using the maxims to generate implicatures

Overview: three ways to generate conversational implicatures:

- **Adhere** to the maxims
- **Violate** the maxims
- **Flout** the maxims

Adhering to the maxims

A: *I've run out of petrol.*

B: *There's a garage just round the corner.*

If B's answer is *relevant* and *informative* (but not *too* informative), it must connect to A's statement in certain ways.

Violating a maxim

A: *Where does Gérard live?*

B: *Somewhere in the South of France.*

B violates Quantity (less information than 'required'). So how is this co-operative?

…this way she adheres to Quality.

Implicature: B doesn't know exactly where Gérard lives.

Flouting maxims

Violating a maxim is enforced (usually by clashing maxims). Flouting is deliberate:

***She produced a series of sounds that roughly corresponded to the score of* Home Sweet Home.**
(flouts Manner)

***John is John.* (flouts Quantity)**

- **Flouting is effectively an invitation to find a new meaning, beyond 'what is said' – one that makes the utterance co-operative after all**
- **Generally associated with particular rhetorical effects**

Rhetorical effects: examples

- Irony and metaphor are two standard forms of maxim-exploiting implicatures:
- Both involve literal falsity
- Both violate the Quality maxim, but:
  - Metaphor involve categorical falsify
    - *She's the cream in my coffee*
  - Irony does not:
    - Irony exploits a contrast between the condition of satisfaction of the speech act and the (common) beliefs.
    - More contrast = more irony
    - *Bush is a lover of peace*

Opting out and manipulating

A speaker may also simply 'opt out' of the Co-operative Principle – i.e. being openly unco-operative:

My lips are sealed; I can say no more.

- **Or non-cooperative with discrete violations:**
  - **Lying: quality maxim**
  - **Confuse: quantity maxim**
  - **Distract: pertinence maxim**

Subtle semantic processes

- A Gricean analysis: *some* has one basic meaning, which has no upper bound
- but, because of Quantity and Quality, an upper bound ('less than all') is usually understood
  - the speaker is as usefully informative as possible
  - knowing whether *all* is true is generally useful information
  - so using *some* instead of *all* communicates that the speaker cannot truthfully assert *all*
  - hence the common meaning 'some but not all', *though this isn't the lexical meaning of some.*

  ('Scalar', 'generalised conversational implicature')

Grice: summary

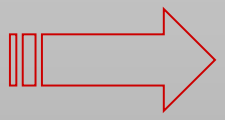
- Assuming co-operation, in line with the maxims, guides the calculation of implicatures:
  - The assumption that the maxims are adhered to points to certain meanings
  - Violation of one maxim usually points to the importance of another
  - Flouting a maxim invites a ‘non-literal’ interpretation

Summary

- Conversational implicature is meaning that is intentionally communicated, but not explicitly
- It is generally thought of as context-dependent, cancellable, non-detachable and calculable meaning
- Implicatures are inferred on the basis of what is explicitly communicated and contextual factors
- According to the Gricean approach, implicatures follow from the conversational maxims that underlie co-operation

Some questions arising

- What's the *status* of the maxims?
  - social or cognitive? learned or innate? universal or cultural?
  - different maxims seem different in nature
- What are the *criteria* for a maxim?
  - How many do we need? How independent are they? (cf. Quantity and Relation; Manner and Quantity)
- *Co-operation* as the basis for utterance interpretation:
  - uncooperative utterances are understood too!
  - 'opting out' is problematic



There is more to be said

Outline of the presentation

- Introduction
- Referential theories of meaning
- Truth conditional theories
- Meaning as usage:
  - Speech Act Theory
  - Grice Maxims
- Applications in computer science/AI
- Conclusion

Applications of those scientific theories

- Truth conditional semantics:
  - Declarative language: texts.
  - Machine translation, advanced text corrector...
  - Automatic summary,
- SAT:
  - Communication between artficial agents: Agent communication languages, dialogue games, protocols, ...
  - Computational linguistic, NLP: dialogue modelling (DRT,...)
  - Human computer interactions
  - Conversation analysis, ...

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Conclusion

- Syntactic level (grammar, ...)
- Referential level (semiotic)
- Propositional level (truth conditional)
- Illocutionary force(s)
- Indirecteness and Implicatures (Gricean Pragmatics)
- Conventional aspects of the use of language (dialectics)
- Cognitive aspects of the use of language

Syntax

Semantics

Pragmatics

Questions

"We have two ears and one mouth so that we can listen twice as much as we speak."

Epictetus