21A.350 / SP.484J / STS.086
The Anthropology of Computing
Fall 2004 MIT

Introduction to the class

This is ANTHROPOLOGY OF COMPUTING — and what that means is that we'll be looking at computers as cultural artifacts, and at the idea of computing itself as connected to wider social, political, economic, ideological, and cultural contexts. In other words, another name for this course would be CULTURES OF COMPUTING. Think of CULTURE as the beliefs, ideas, ideologies that organize people's ways of life and that are also built into the technologies, infrastructures they use and inhabit.

I've organized this class roughly historically, at least to begin — since understanding how ideas about computation, calculation, cognition have *changed* can afford insight into the various ways that computers have come into being. We will also pay attention to different cultural genealogies, heritages for computing, particularly in reading we do about African mathematical systems in November.

Why culture? "It is a good thing to know something of the customs and manners of various peoples in order to judge our own more objectively and not think everything which is contrary to our ways ridiculous and irrational, as those who have seen nothing are in the habit of doing" (Descartes, 30)

This course is cross-listed with Science Technology and Society.

It's also cross-listed with Women's Studies, since some of the cultural contexts we read about in this class have quite a bit to do with gender — ideas and social structures organized around perceived differences between the so-called sexes. This will become particularly relevant, for example, when we read about the early history of Artificial Intelligence and ask whether the MIND as the AI folks modeled it contained assumptions about the relation between gender and reason. Why is it always MAN versus MACHINE?

Course Logistics

A word about presentations: Students will give a presentation exploring the social meaning of an artifact from contemporary computing not covered in our reading — e.g. the iPod, XBox, Google.

As I calculate it, we have 5 sessions in which it will make sense to do this — times when a paper isn't due, or we don't have a guest speaker, or its too early to make you freak out. Given that there are X people in the class, that means X/5 per session. We'll start the time after next. I'll create a sign up sheet for that and we can talk in more detail then.

MEDIEVAL AND RENAISSANCE COSMOLOGY AND CLOCKWORK
Lecture 2. September 20

I'll speak today about the emergence of early models of the mind in coordination and calibration with particular Christian cosmologies, particularly in medieval and Renaissance Europe.

Several important figures in the early history of mathematics and logic turn out to have had mutually informing investments in ideas about the *cosmos*, about God, and about the place of humans in understanding the order created by God, whom they imagined, in line with much Christian theology, as omnipotent, omniscient, and benevolent.

I'll lecture today about Lull and Descartes, and more briefly about Pascal and Leibniz. The Channell chapters you read are background.

Why did I have you read these excerpts about the human mind and the mind of God? Because I want you to begin to make connections between the models of the mind that these people formulated and their larger cultural surroundings, specifically the ways they tried to coordinate or locate their ideas about the mind — or the soul, sometimes — in a Christian cosmological order presided over by a singular all-powerful God.

Descartes, Pascal, and Leibniz are all important thinkers in the history of logic, proof, calculation, and cognition, and *therefore* absolutely foundational for theorizing what would eventually be called COMPUTATION.

This is not to say that the history of Christianity hasn't been porous, interacting with what we think of as the other major monotheistic religions or the Book: Judaism, Islam.

Indeed, ZERO comes to European mathematics from Hindu mathematics via Arabic mathematics and there were many people who opposed, on theological grounds, a symbol which could be both a number and a placeholder for the absence of number. Zero threatened their idea about God as always present.

Let's go back to the 13th century to examine the ways particular Christian cosmologies got written into ideas about reasoning, starting with this character you read something about:

RAMON LULL

Ramon Lull was a Catholic (Franciscan) Catalonian mystic in the 13th century who — after a mystical experience in 1274, in which he saw the attributes of God arrayed in letters on a bush — attempted to develop a logical method for arriving at true knowledge of the world, the universe, and God.

Toward this goal, as you read, he invented mechanical contrivances, logical machines, in which the subjects and predicates of theological propositions were arranged in circles, squares, triangles, and other geometrical figures, so that by moving a lever, turning a crank, or turning a wheel, the propositions would arrange

themselves in the affirmative or negative and thus prove themselves to be true or false.

He incorporated into his system of concentric wheels circuits corresponding to steps of the levels of creation, letters of the alphabet, and the attributes of God.

This device was called the *Ars Magna* and he wrote many books about its method.

Why was he interested in proving logically those aspects of religion that one might think would be simple matters of faith rather than reason? Weren't theology and natural philosophy separate things? No, for Lull there was *no difference* between natural and supernatural truth; faith and reason must work together.

Historical context: After the Crusades had failed to have their promised effect, Lull wanted to prove by irrefutable reasoning the truth of Catholicism to Muslims. Reason would be the new tool for spreading the faith. And he went to Africa on a few occasions to debate with rival theologians and reach Muslims.

So how did these devices work?

He thought that in every branch of knowledge there were simple principles or categories that could be assumed without question. By combining in all possible permutations these categories, we could find all the knowledge we were capable of understanding, and could also separate truth from falsity.

This was a sort of deductive method, a mnemonic (memory) device.

Truths about God, the soul, and about relations between things might be derived, and you might answer theological conundrums too: "Can God take matter without form?"

> "Permutation of the positions of these generated correspondences and associations that he used to convince Jews and Moslems that the mystical meanings of the Jewish caballa and of the Sufist names or aspects of God could be integrated through the Christian trinity into one philosophical scheme."

Now, of course, to make a pun, Lull's machines were based on circular reasoning, assuming as axiomatic the bases of the very principles he wished to demonstrate. They functioned to affirm his worldview.

Let me pause and point something out that might be so obvious, you haven't thought of it.

There is something that these early logical devices have *in common* with today's computers — and that is, the promise that, if properly functioning, computers are supposed to operate consistently and rationally, and even deliver to us TRUTH values. More than this, the truth values are supposed to REFLECT what the world is like.

Indeed, the definition of logic in the OED has logic as a

Logic

1. a . A formal system using symbolic techniques and mathematical methods to establish truth-values in the physical sciences, in language, and in philosophical argument.

4. *Computers and Electronics*. a. The system or principles underlying the representation of logical operations and two-valued variables by electrical or other physical signals and their interactions; the forms and interconnections of logic elements in any particular piece of equipment, in so far as they relate to the interaction of signals and not to the physical nature of the components used; also, the actual components and circuitry; logical operations collectively, as performed by electronic or other devices.

We *have not abandoned* the idea that logic, calculation is about TRUTH, even as, in the centuries after the Renaissance and the Enlightenment, many of us now believe that, when it comes to logic, this truth is located more in matters mathematical than mystical.

But the mystical and the mathematical were not separate things at the time Lull wrote. Indeed, the unity of the cosmos and the human soul was assumed. Monotheists like Lull believed that there was one universe, one God — and that humanity, which they glossed as MAN, was made in HIS image. Correspondences.

Four elements. Four humors.

Lull's system partook of this epistemology (how you know you know things), perhaps nowhere more clearly than in his astrological devices.

Lull was a believer in astrology "his circles could be used to reveal various favorable and unfavorable combinations of planets within the zodiac"

Medieval cosmology was governed by reasoning by resemblances. Macrocosm/ **microcosm**.

The *Ars Magna* was supposed to reveal the order of God's world to humans, through their faculty of reason. Now, *if humans were so reasonable*, why wasn't the order immediately apparent to them as they walked around the world?

Well, because they had SINNED. They had left Eden, gotten out of the perfect climate and humor and forgotten this order.

The *Ars Magna* would enable the ascent of the mind of the individual to the level of the mind of God. You stay at your calculating machine long enough and you will see God.

This link between the universe and the mind — this notion that understanding the cosmos (which means the ordered universe) and one's place in it was indispensable to any proper system of reasoning — endured into the Renaissance. But where early

medieval cosmology made the link between universe and mind through a theory of correspondences (shared properties, natures, and essences), Renaissance cosmology had a different epistemology — one of representation (intellectual connections) — and had a new tool for drawing analogies (not identifications) between the microcosm and macrocosm, and this was the CLOCKWORK.

God became a divine watchmaker, especially after Boyle (Channell, p. 22), who compared the universe to a rare clock from Strasburg.

THE CLOCKWORK UNIVERSE AND MIND

Understanding the universe, God's plan, still meant mapping that plan, but now clocks were those maps. Of course, as Channel points out, this metaphor was a long time in coming and has precedents in classical antiquity. Aristotle thought that the universe was a mechanical system of sorts. And remember Pythagoras, who thought the universe was made of numbers.

DESCARTES

Like Lull, Descartes, a French philosopher of the 17th century, was committed to using reason to prove the truth of God. He also wanted philosophy to have the same certitude as mathematics. But there were differences, too. Like what?

> Slammed Lull (p. 40) for conflating logical manipulation with knowing:
>
> "Regarding logic, its syllogisms and most of its other precepts serve more to explain to others what one already knows, or even, like the art of Lully, to speak without judgment of those things one does not know, than to learn anything new."
>
> We will see this debate about the relation between calculation, cognition, and consciousness repeated in twentieth century debates about AI

So, what was Descartes method? (p. 41) How did it work? And what was knowledge? And the mind?

1. accept only what is presented to the mind so clearly that one cannot doubt it

> what must you doubt? SENSES!
>
> can't even be sure that you have a body! mind/body split
>
> only thing of which one can be certain is that one is thinking;
> *cogito ergo sum*
> the body is like a machine, it is passive; senses are deceptive.
>
> "I concluded that I was a substance, of which the whole essence or nature consists in thinking, and which, in order to exist, needs no place and depends on no material thing" (p. 54).
>
> defined reality in terms of clear and distinct ideas in the mind

he's reasoning from luxury: "I was not, thank Heaven, in the position of having to make a trade of knowledge to supplement my fortune" (p. 32).

And speaking of heaven, Descartes is able to prove the existence of God.

How?

How can you know that you are not perfect? Well, must come from knowledge that perfection can exist. This perfection is God (p. 55).

The reasoner is identified with a transcendent and infinite God, one not chained to a body. One reasons in God's image, though less perfectly.

Newton said that the "universe is the sensorium of God." The spatialization of the mind? Architectural and political/state metaphors, too.

The world is lifeless matter in motion

2. analyze by dividing into parts
3. move from simple to complex
4. apply solution to broadest context possible

the body is a machine (vivisection interlude 66!) animals as machines (p. 73).

Later theorists Hobbes and LaMettrie rejected the separation between matter and mind; body and mind are both machines!

PASCAL (1623 - 1662)

Contemporary with Descartes. A French mathematician interested in geometry and math from an early age and also quite a religious Christian.

In 1642, at the age of 19, he constructed the first arithmetical machine, or digital calculator — to help his father with his work collecting taxes. He worked on it for three years.

There were problems faced by Pascal in the design of the calculator that were due to the design of the French currency — which wasn't based around even divisions of ten or any other number for that matter. There were 20 sols in a livre and 12 deniers in a sol. The system endured in France until 1799. Pascal had to solve much harder technical problems to work with this division of the livre into 240 than he would have had the division been 100.

By 1652 fifty prototypes had been produced, but few machines were sold, and manufacture of Pascal's arithmetical calculator ceased in that year.

Pascal took a turn for the more religious in the 1650s, after a carriage accident involving runaway horses — which he considered a call to abandon the world for God.

As a mathematician Pascal is best known in connection with his correspondence with Fermat in the 1650s in which he laid down the principles of the theory of probabilities.

He made an interesting use of the new theory in the seventh chapter of his *Pensées*, his most famous work, on human suffering and God. This work contains 'Pascal's wager,' which claims to prove that belief in God is rational with the following argument:

If God does not exist, one will lose nothing by believing in him, while if he does exist, one will lose everything by not believing.

In effect, he puts his argument in the language of probability.

LEIBNIZ (1646-1716)

Famous for inventing the Calculus at the same time as Isaac Newton, but was also interested in coming up with a system to collate all human knowledge. A Lutheran who was very tolerant of Catholics, he also had a lifelong dream of reunifying the Church. And dreamt of doing this using reason and logic. Remember from Gardner: “Let us calculate.”

After being awarded a bachelor's degree in law, Leibniz worked on a degree in philosophy. His work was published in 1666 as a *Dissertation on the combinatorial art*. In this work Leibniz aimed to reduce all reasoning and discovery to a combination of basic elements such as numbers, letters, sounds and colors. And he was clearly inspired by Lull.

His view of the universe was that God was transcendent over it, set it running and then sat back. *This against Newton, who thought God was immanent and intervened to keep it running*. For Leibniz, it was a clock with no upkeep — though it was also imperfect, which made it distinct from God. He also claims that the universe is the best possible without being perfect. Leibnizian reasoning will reappear in Norbert Wiener’s cybernetics.

He believed that mathematics is the language of nature; everything can be understood through numbers (recall Pythagoras, who believed that the world was made of numbers). Cellular automata.

Y2K

The idea of a clockwork universe, the logic of which might be built into computational devices is still with us — and nowhere more vividly in recent years with the panic surrounding Y2K.

…

What do you think happened? Why were people panicked?

Monotheistic — indeed Christian — cast of early thinking about the mind/soul has not vanished from the clockwork of contemporary computing. The sorts of fears and hopes that people had about Y2K were animated by ideas about Biblical apocalypse.

This is no surprise since the calendar of Christianity has been built into our machines.

Numerology versus mathematics. WWW=666

People were possessed of a sense that the technology of computers operated independently of people. *Or that everything about society went through computers.*

e.g. *The Matrix*

I want you to take seriously the idea that many of our cultural lives are increasingly entangled with computers, though not therefore in control of them.

Mapping how that entanglement happens, what cultural meanings are assigned to computers and built into them, is the task of this class.

MOVIE: PI

NEXT TIME:
The Enlightenment secularized and rationalized all this, connected to industrial revolution.

Industrial capitalism, the factory system, and models of calculation, gender of the worker