IST 4
Information and Logic
Tuesday
Thursday
2:30-4:00
Annenberg 105

Lecturer: Shuki Bruck
331 Moore
Office hours:
Tuesday, Thursday; 4-5pm
Office hours at SFL study room, 2nd floor:
- Monday (or Friday): 4-5pm; 9-10:30pm
- Wednesday: 4-5pm; 9-10:30pm
For questions: ta4@paradise.caltech.edu
web site: paradise.caltech.edu/ist4/
Secretary: Michelle Chen; 304 Moore
What is the most important part of your studies at Caltech?
The most important part of your studies at Caltech?

Discover your passion and your gifts!

Learn to ask questions

Do not worry about forgetting the answers
Diverse and fast change leads to the mechanization of teaching

In contrast...

We typically focus on teaching tools...
Make the subject of Information and Logic unfamiliar...

How?

Teach about the historical innovation process and the related inventors
"Art as Technique"
by: Viktor Shklovsky

1925

“If we start to examine the general laws of perception, we see that as perception becomes habitual, it becomes automatic”
"Art as Technique"

by: Viktor Shklovsky

"if one remembers the sensations of holding a pen...

...for the first time and compares that with his feeling at performing the action for the ten thousandth time, he will agree with us"
"Art as Technique"
by: Viktor Shklovsky

1925

"The purpose of art is to impart the sensation of things as they are perceived and not as they are known"

The purpose of IST4 is to impart the sensation of ideas as they are conceived and not as they are known.
Time
The Universe ~14 Billion years ago (ya)

Earth ~4.5 Billion ya

Life on earth ~3.7 Billion ya

What is life?
What is life?

It is a natural information system.
Questions about Life:

Origins?

Memory?

Rewriting?
Questions about Life:

Origins?

Memory?

Rewriting?

Mutation?

Selection?

New species?

DNA
Life appeared on earth \(~3.7\) Bya

**Life is a information/memory Machine**
It is autonomous, can develop, replicate, evolve, adapt, learn, and communicate in space and time

The appearance of life is an **Information-based Megamorphosis**
~$10^{30}$ bacterial cells in the world

The appearance of life is an Information-based *Megamorphosis*. However, a human body has $10^{13}$ cells.

The appearance of life is the first Information Megamorphosis.

What is the second Information Megamorphosis?

The appearance of the human brain is the second Information Megamorphosis.
What is special about the human brain?
What is special about the Human Brain?

Written languages
5Kya

Spoken languages
60Kya

H-Sapiens 200Kya
Bigger Brain 2Mya

Tools 2Mya
Bipedalism 4Mya

Life 3.7Bya
Earth 4Bya

Human expansion led to the extermination of most of the large mammals like the giant sloths

Verbal language - 50Kya
Questions about the human brain:

Origins?  
Memory?
Rewriting?
Origins?  ??

- **Invention** - artificial tool - to augment skills
  physical skills vs memory/communications skills

- **Separation** - between the time / place created
  and time / place used

- **Teaching** - the skills to the next generations
Questions about the human brain:

- Origins?
- Memory?
- Languages and...
- Rewriting?

Experience, learning, ...

New compositions/languages.
Questions about Life:

- Origins?
- Memory?
- Rewriting?
- Mutation?
- Selection?
- New species?
- DNA
Compare and contrast

Memory... DNA... Rewriting

Memory... Languages and... Rewriting

natural... artificial...
We are “memory machines”

However, our memory sense is limited...
Can You Remember the Following Table?
Can You Remember the Following Table?
Can You Remember the Following Table?

What is the second digit in the second row?

Do all the digits 0...9 appear?
Name a missing digit!

Name a digit that appears more than once! twice!
Can You Remember the Following Table?

What is the second digit in the second row?

Do all the digits 0...9 appear?
Name a missing digit!

Name a digit that appears more than once! twice!
Can You Remember the Following Table?

What is the sum of the digits in the last row?
Can You Remember the Following Table?

<table>
<thead>
<tr>
<th>What is the sum of the digits in the last row?</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 6 8 0</td>
</tr>
<tr>
<td>5 4 3 2</td>
</tr>
<tr>
<td>1 6 8 4</td>
</tr>
<tr>
<td>7 9 3 5</td>
</tr>
<tr>
<td>4 2 3 7</td>
</tr>
</tbody>
</table>
Can You Remember the Following Table?

S could do it and more!

Solomon Shereshevskii (S)
1886 - 1958, Moscow
Absolute Memory

1968

Luria studied the memory of S from the mid 1920s for about thirty years...

This research account is documented in a nice little book

Alexander Luria
1902 - 1977, Moscow

Solomon Shereshevskii (S)
1886 - 1958, Moscow
An Amazing Memory

He spent **three minutes** examining the table...

It took him **40 seconds** to reproduce this table, that is, to call off all the numbers in succession...
An Amazing Memory

...an experiment designed to verify S.'s “reading” of this series, which was not carried out until several months had elapsed...

... he could reproduce the table he had “impressed” in his mind just as fully as in the first reproduction and at about the same rates
An Amazing Memory

Information Recall is Associative

The only difference in the two performances is that for the later one he needed more time to revive the entire situation in which the experiment had originally been carried out....
We are “memory machines”

However, our memory sense is limited...

A natural language is an artificial memory???

Need to augment with artificial memory
Dog

łeł

Three
Artificial memory

Memory

natural and artificial languages

Rewriting

New encodings/languages…
Q: Emergence of new languages?
Q: Emergence of new languages?

English, Chinese, Spanish, ...

Algebra, Calculus, Physics, Chemistry, C++...

Music, Dance, Painting...

History, Anthropology, Law, Medicine...

new languages facilitate efficient management of our memory “understanding”
Q: Emergence of new languages?

Need to invent of **artificial memory devices** for storing information captured by the different languages.

New languages facilitate efficient management of our memory "understanding"
Homo Sapiens started in Africa 150ya
About 2,000 people....

Spoken languages 60Kya
Writing 5Kya

new languages

Need to invent of artificial memory devices for storing information captured by the different languages

additional memory capacity

what do we have in memory?
your first assignment...
Everyone has a gift!

"I have no special talents. I am only passionately curious."

Albert Einstein
Everyone has a gift!

Due Thursday 4/9/2015 at 10pm

• You are invited to write short essay on the topic of the Magenta Question. Extra Credit of 3 points
Everyone has a gift!

Due Thursday 4/9/2015 at 10pm

• You are invited to write short essay on the topic of the Magenta Question.
• Recommended length is 3 pages (not more)
• Submit the essay in PDF format to ta4@paradise.caltech.edu
  file name lastname-firstname.pdf
• No collaboration. No extensions

Grading of MQ:
3 points (out of 103)

50% for content quality, 50% for writing quality

Some students will be given an opportunity to give a short presentation for up to 3 additional points
2014 - Everyone has a Gift!

1. Diana Ardelean - The Gift of Becoming a GO Player
2. Shalini Majumdar - The Gift of Companionship
3. Alex Geffner-Mihlsten - The Gift of Names and Lives
4. Sumana Mahata - The Gift of Laughter
5. Parth Shah - My Mother has the Greatest of all Gifts!
6. Tim Menninger - Colors
7. Nasser Al Rayes - Boo (The Gift of Being Tall)
8. Sophia Yuenchih Chen - The Gift of Uniqueness
organizational details...
<table>
<thead>
<tr>
<th>mon</th>
<th>tue</th>
<th>wed</th>
<th>thr</th>
<th>fri</th>
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</thead>
<tbody>
<tr>
<td>30</td>
<td>M₁</td>
<td>T</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>oh</td>
<td></td>
<td>M₁</td>
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<td>2 M₂</td>
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<td>27</td>
<td>oh</td>
<td>M₂ oh</td>
<td></td>
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<td>3</td>
<td>oh</td>
<td></td>
<td>oh</td>
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<tr>
<td>11</td>
<td>oh</td>
<td>3 oh</td>
<td>4</td>
<td></td>
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<tr>
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<td>oh</td>
<td>oh</td>
<td>4 oh</td>
<td>5</td>
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<td>25</td>
<td></td>
<td>oh</td>
<td>oh</td>
<td></td>
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<tr>
<td>1</td>
<td>oh</td>
<td>oh</td>
<td>oh</td>
<td></td>
</tr>
</tbody>
</table>

**T** = today

x = hw#x out

x = hw#x due

oh = office hours

Mx = MQx out

Mx = MQx due


Class Policy

There is no midterm and no final

Homework sets
There are 5 homework sets; all weighted equally
The total weight of the 5 homework assignments is 94 points

Essays
There are two essays, 3 points each
A selected set of students are given the opportunity to present their essay in class (3 points)

However,
to be eligible to receive credit for essays / presentations/ extra credit, a student has to fully attend at least 16 lectures (out of 20), must attend the last two lectures (at least 14+2)
Class Policy

Final Grade

At the end of the term, a student that satisfied the attendance requirement should send an email to ta4@paradise.caltech.edu declaring this fact.

The final grade is calculated based on the grades of the homeworks and the essays / presentations (if the student is eligible) and will be converted to a letter grade:

<table>
<thead>
<tr>
<th>Grade Range</th>
<th>Letter Grade</th>
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</thead>
<tbody>
<tr>
<td>96-103</td>
<td>A+</td>
</tr>
<tr>
<td>86-95</td>
<td>A</td>
</tr>
<tr>
<td>76-85</td>
<td>B</td>
</tr>
<tr>
<td>66-75</td>
<td>C</td>
</tr>
<tr>
<td>&lt; 66</td>
<td>F</td>
</tr>
</tbody>
</table>
Class Policy

Collaboration and Open-Book policy

Collaboration, in the sense of discussing how to solve the homework problems, is allowed on some, but not all, homework problems. Every homework problem includes a specific statement whether collaboration is allowed or not.

For all homeworks:
- Write the final solutions of the homeworks alone and understand them fully.
- Books, papers, notes can be consulted, but not copied from.
- The use of solutions from previous years is not allowed.
Class Policy - Homeworks

• Homeworks are to be submitted in class. They are due at the start of class on the due date.

• Homeworks are returned in class. Keep your graded sets until you get the final grade. That’s your record.

• Late homeworks lose 20% of their value immediately and lose 100% of their value a week after the due date except in institute-established cases of illness or emergency.

• A late homework submission should include only solutions to problems that were not attempted in the previous (on-time) submission.

• We are human... and occasionally make mistakes in grading; corrections of grades should be requested within a week from the time the graded homeworks were returned.
There is no Text

Reference Books

• The reference books are recommended as sources for extending your knowledge beyond what is covered in class.

• They are not a required reading.

• The list is posted on the class website.

• The books are reserved at the Caltech library (SFL).
Take-homes from today:

DNA is the language of life...

Language is the DNA of ideas...

We are memory machines augmented with artificial memories
IST 4:
Explore the evolution of ideas in information and logic.