

CS4442/9542b
Artificial Intelligence II
Prof. Olga Veksler

Lecture 1
Course Introduction

Outline

- Syllabus
- Course Introduction
 - Machine Learning (**ML**)
 - Natural Language Processing (**NLP**)
 - Computer Vision (**CV**)

Syllabus

- Formal Prerequisites
 - AI 1 (CS 346)
 - not really necessary
 - CS2210
 - First-year course in Calculus
 - Some Linear Algebra
- Grading
 - 3 Short (1 hour) quizzes 18% each
 - Programming assignments (16%, 15%, 15 %)
 - in Matlab (and maybe C/C++)
 - I will give a short introduction to Matlab

Syllabus

- Assignments
 - may discuss but **work must be done individually**
 - We will use an automatic program to check for cheating
 - Hand in by the midnight on the due date
 - Submission via WEBCT
 - Late penalty
 - 5% one day late
 - 10% two days late
 - 15% three days late
 - 20% four days late
 - Not accepted after 4 days
 - Sat and Sun count as 1 day

Syllabus

- 3 short easy (really) quizzes
 - 1 hour each
 - open lecture notes
 - calculators OK, but no other electronic devices

Textbooks

- **We will not follow this textbook too closely**
- You should attend lectures, we will cover a lot of material not in the textbook
- No required, only recommended books
- Useful books:
 - ML: Duda, Hart, Stork, **Pattern Classification**, second edition.
 - NLP: Manning and Schutze, **Foundations of Statistical Natural Language Processing**
 - CV: R. Szeliski, **Computer Vision: Algorithms and Applications**
 - General AI: **Artificial Intelligence: A Modern Approach** second edition, S. Russell and P. Norvig

Course Intro: What is AI?

- Branch of computer science which
 - is the science of making machines do things that would require intelligence if done by men (Minsky)
 - is the exciting new effort to make computers think (Haugeland)
 - is the study of the computations that make it possible to perceive, reason, and act (Winston)
 - is the study of how to do things which at the moment people do better (Rich & Knight)
- “Artificial Intelligence” term was coined in 1956 by John McCarthy at MIT

Course Intro

- AI is an extensive field of Computer Science
- In this course, we offer a brief introduction three sub-fields of AI
 - Machine Learning
 - Natural Language processing
 - Computer Vision

What is Machine Learning?

- *Develop algorithms that allow computers to “learn”*
- In this course, we use a rather narrow definition of “learning”
 - Learn to assign an **object** or an **example** to one of the several pre-specified **categories** (a category is usually called a **class**)
 - also called *Pattern Recognition*
- Example:



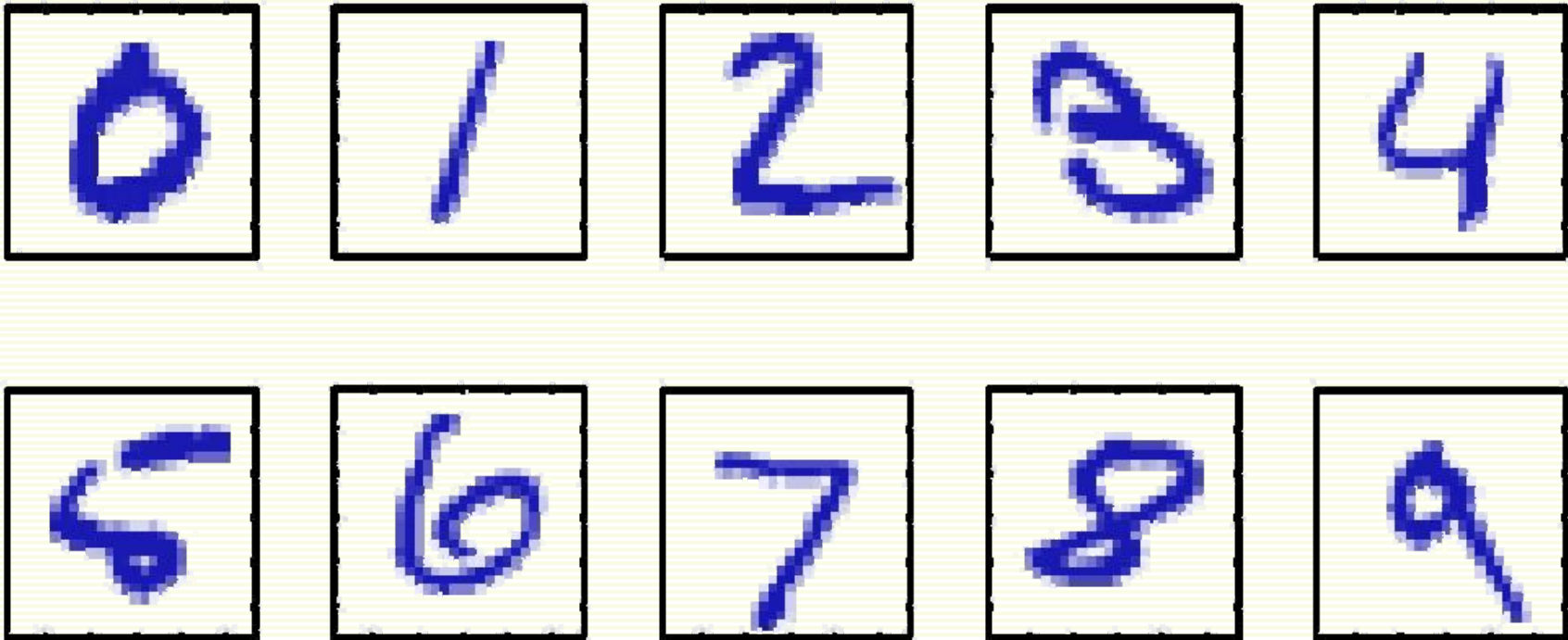
tea cup

face

phone

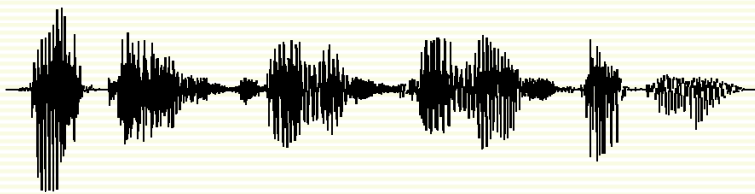
ML Application: Digit Recognition

- Objects – images
- Classes – digits 0, 1, ...,9



ML Application: speech understanding

- Objects – acoustic signals
- Classes – phonemes



re-kig-'ni-sh&n

ML Application: Loan Approvals

- Objects – people
- Classes – “approve”, “deny”

	income	debt	married	age	approve	deny
John Smith	200,000	0	yes	80		<input checked="" type="checkbox"/>
Peter White	60,000	1,000	no	30	<input checked="" type="checkbox"/>	
Ann Clark	100,000	10,000	yes	40	<input checked="" type="checkbox"/>	
Susan Ho	0	20,000	no	25		<input checked="" type="checkbox"/>

What is Natural Language Processing?

- Develop computers that can understand human (“natural”) language and speak human language
- Computers would be much easier to use with Natural Language Interface
- Can we “teach” them to understand human language?
 - Many approaches to NLP are based on Machine Learning

NLP Application: Machine Translation

Президент США пока не принял решение, следует ли расширить американское военное присутствие в Ираке.

Russian
news
→
Babel fish

The President OF THE USA thus far did not accept the solution, should be enlarged American military presence in Iraq.

does not work so well for poetry

А вы, мои друзья последнего призыва!
Чтоб вас оплакивать, мне жизнь сохранена.
Над вашей памятью не стыть плакучей ивой,
А крикнуть на весь мир все ваши имена!
Да что там имена!
Ведь все равно — вы с нами!..
Все на колени, все!
Багряный хлынул свет!
И ленинградцы вновь идут сквозь дым
рядами —
Живые с мертвыми: для славы мертвых нет.

Russian
poetry
→
Babel fish

But you, my friends of last call! In order you to mourn, to me life is preserved. Above your memory not to cool by weeping willow, A to shout to entire peace all your names! Yes that there names! Indeed nevertheless - you with us!.. All to the elbows, everything! Crimson gushed out light! And residents of Leningrad again go through the smoke by numbers - living with the corpses: there are no corpses for the glory.

NLP Application: Speech Synthesis

- Text to speech
- <http://www.cepstral.com/>

"My latest **project** is to learn how to better **project** my voice"



speech

disambiguates parts of speech

NLP Application: Automatic Summarization

Three Bears Story

Once upon a time there were three Bears, who lived together in a house of their own, in a wood. One of them was a Little Wee Bear, and one was a Middle-sized Bear, and the other was a Great Big Bear. One day, after they had made the porridge for their breakfast, and poured it into their porridge-bowls, they walked out into the wood while the porridge was cooling, that they might not burn their mouths by beginning too soon, for they were polite, well-brought-up Bears. And while they were away a little girl called Goldilocks, who lived at the other side of the wood and had been sent on an errand by her mother, passed by the house, and looked in at the window. And then she peeped in at the keyhole, for she was not at all a well-brought-up little girl. Then seeing nobody in the house she lifted the latch. The door was not fastened, because the Bears were good Bears, who did nobody any harm, and never suspected that anybody would harm them. So Goldilocks opened the door and went in; and well pleased was she when she saw the porridge on the table. If she had been a well-brought-up little girl she would have waited till the Bears came home, and then, perhaps, they would have asked her to breakfast; for they were good Bears--a little rough or so, as the manner of Bears is, but for all that very good-natured and hospitable. But she was an impudent, rude little girl, and so she set about helping herself. First she tasted the porridge of the Great Big Bear, and that was too hot for her. Next she tasted the porridge of the Middle-sized Bear, but that was too cold for her. And then she went to the porridge of the Little Wee Bear, and tasted it, and that was neither too hot nor too cold, but just right, and she liked it so well that she ate it all up, every bit! Then Goldilocks, who was tired, for she had been catching butterflies instead of running on her errand, sate down in the chair of the Great Big Bear, but that was too hard for her. And then she sate down in the chair of the Middle-sized Bear, and that was too soft for her. But when she sat down in the chair of the Little Wee Bear, that was neither too hard nor too soft, but just right. So she seated herself in it, and there she sate till the bottom of the chair came out, and down she came, plump upon the ground; and that made her very cross, for she was a bad-tempered little girl. Now, being determined to rest, Goldilocks went upstairs into the bedchamber in which the Three Bears slept. And first she lay down upon the bed of the Great Big Bear, but that was too high at the head for her. And next she lay down upon the bed of the Middle-sized Bear, and that was too high at the foot for her. And then she lay down upon the bed of the Little Wee Bear, and that was neither too high at the head nor at the foot, but just right. So she covered herself up comfortably, and lay there till she fell fast asleep. By this time the Three Bears thought their porridge would be cool enough for them to eat it properly; so they came home to breakfast. Now careless Goldilocks had left the spoon of the Great Big Bear standing in his porridge. "SOMEBODY HAS BEEN AT MY PORRIDGE!" said the Great Big Bear in his great, rough, gruff voice. Then the Middle-sized Bear looked at his porridge and saw the spoon was standing in it too. "SOMEBODY HAS BEEN AT MY PORRIDGE!" said the Middle-sized Bear in his middle-sized voice. Then the Little Wee Bear looked at his, and there was the spoon in the porridge-bowl, but the porridge was all gone! "SOMEBODY HAS BEEN AT MY PORRIDGE, AND HAS EATEN IT ALL UP!" said the Little Wee Bear in his little wee voice. Upon this the Three Bears, seeing that some one had entered their house, and eaten up the Little Wee Bear's breakfast, began to look about them. Now the careless Goldilocks had not put the hard cushion straight when she rose from the chair of the Great Big Bear. "SOMEBODY HAS BEEN SITTING IN MY CHAIR!" said the Great Big Bear in his great, rough, gruff voice. And the careless Goldilocks had squatted down the soft cushion of the Middle-sized Bear. "SOMEBODY HAS BEEN SITTING IN MY CHAIR!" said the Middle-sized Bear in his middle-sized voice. "SOMEBODY HAS BEEN SITTING IN MY CHAIR, AND HAS SATE THE BOTTOM THROUGH!" said the Little Wee Bear in his little wee voice. Then the Three Bears thought they had better make further search in case it was a burglar, so they went upstairs into their bedchamber. Now Goldilocks had pulled the pillow of the Great Big Bear out of its place. "SOMEBODY HAS BEEN LYING IN MY BED!" said the Great Big Bear in his great, rough, gruff voice. And Goldilocks had pulled the bolster of the Middle-sized Bear out of its place. "SOMEBODY HAS BEEN LYING IN MY BED!" said the Middle-sized Bear in his middle-sized voice. But when the Little Wee Bear came to look at his bed, there was the bolster in its place! And the pillow was in its place upon the bolster! And upon the pillow----? There was Goldilocks's yellow head--which was not in its place, for she had no business there. "SOMEBODY HAS BEEN LYING IN MY BED,--AND HERE SHE IS STILL!" said the Little Wee Bear in his little wee voice. Now Goldilocks had heard in her sleep the great, rough, gruff voice of the Great Big Bear; but she was so fast asleep that it was no more to her than the roaring of wind, or the rumbling of thunder. And she had heard the middle-sized voice of the Middle-sized Bear, but it was only as if she had heard some one speaking in a dream. But when she heard the little wee voice of the Little Wee Bear, it was so sharp, and so shrill, that it awakened her at once. Up she started, and when she saw the Three Bears on one side of the bed, she tumbled herself out at the other, and ran to the window. Now the window was open, because the Bears, like good, tidy Bears, as they were, always opened their bedchamber window when they got up in the morning. So naughty, frightened little Goldilocks jumped; and whether she broke her neck in the fall, or ran into the wood and was lost there, or found her way out of the wood and got whipped for being a bad girl and playing truant, no one can say. But the Three Bears never saw anything more of her.

Summary by "Mead"

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What is Computer Vision?

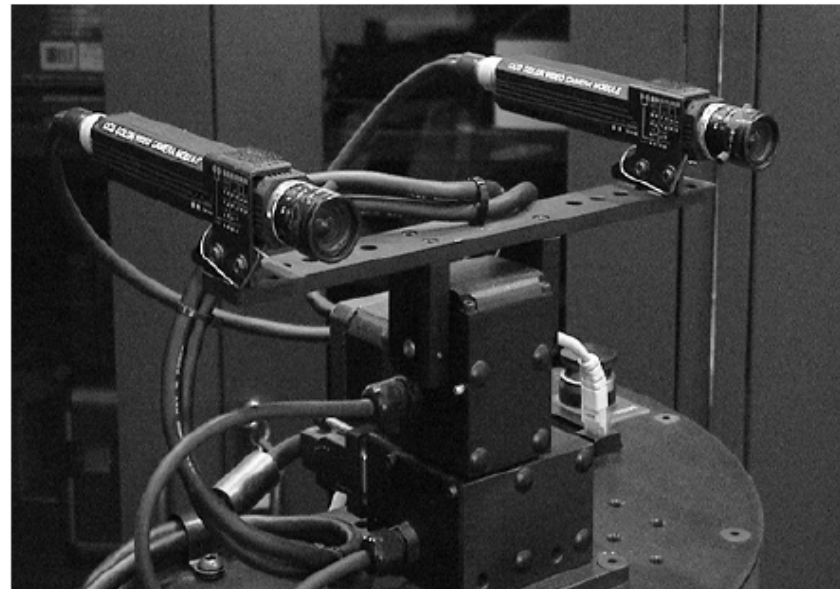
- How to design computers that can see (that is understand and interpret information in images/video)
- Vision is our primary tool for experiencing the world
 - Approximately 50% of cerebral cortex is for vision
- Computer vision is immensely useful for a variety of applications

CV Application: Face Detection



Viola and Jones

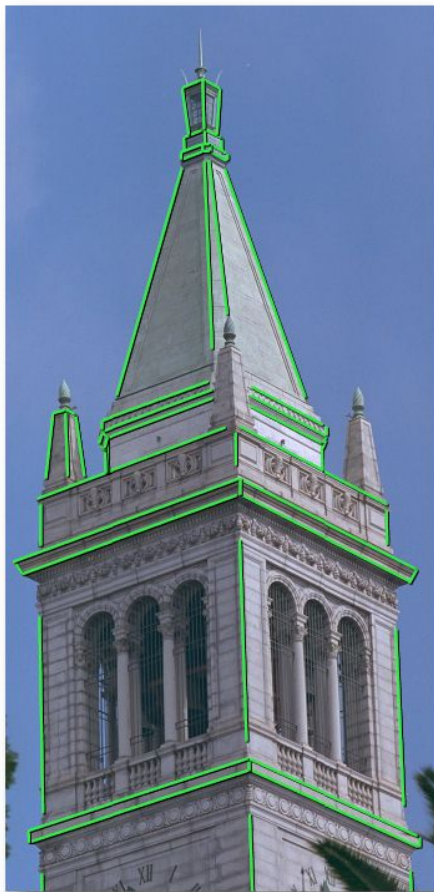
CV Application: Robot Navigation



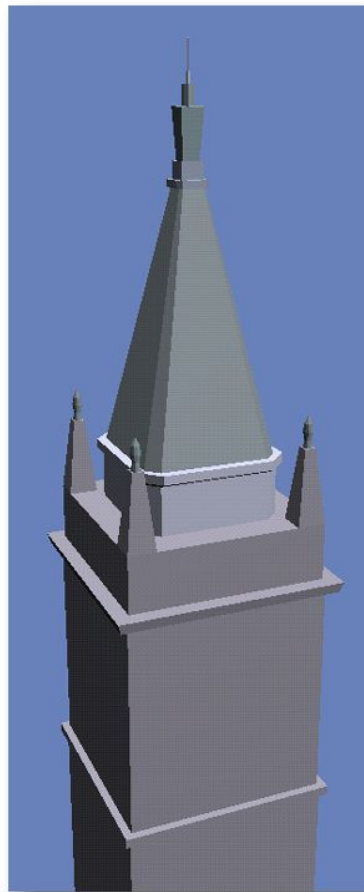
CV Application: 3D modeling

Modeling and Rendering Architecture from Photographs

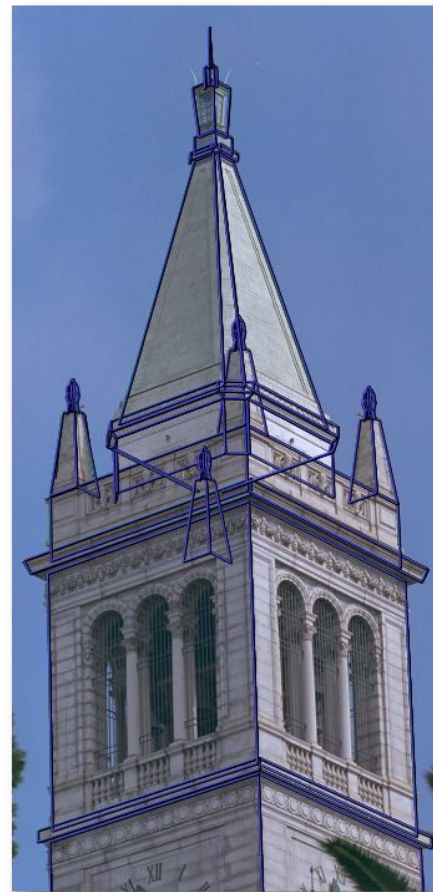
Debevec, Taylor, and Malik 1996



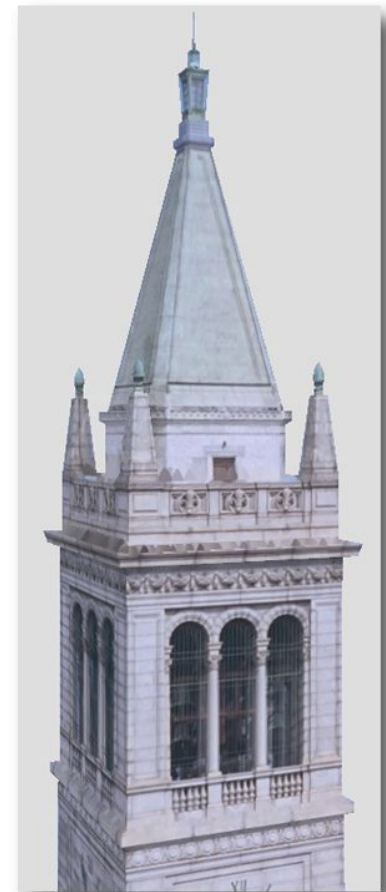
Original photograph with marked edges



Recovered model

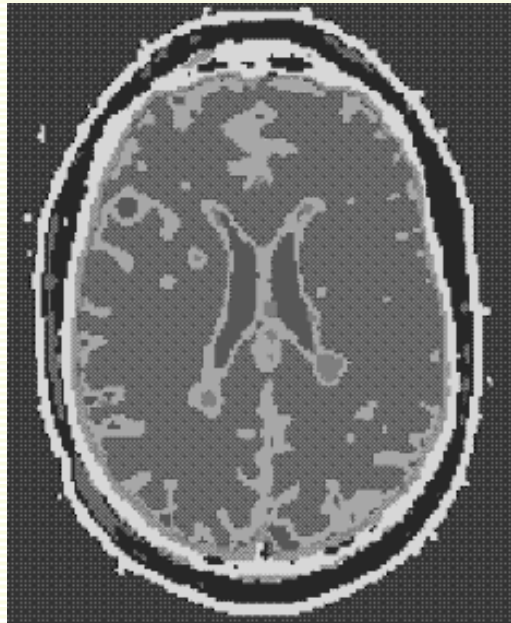


Model edges projected onto photograph

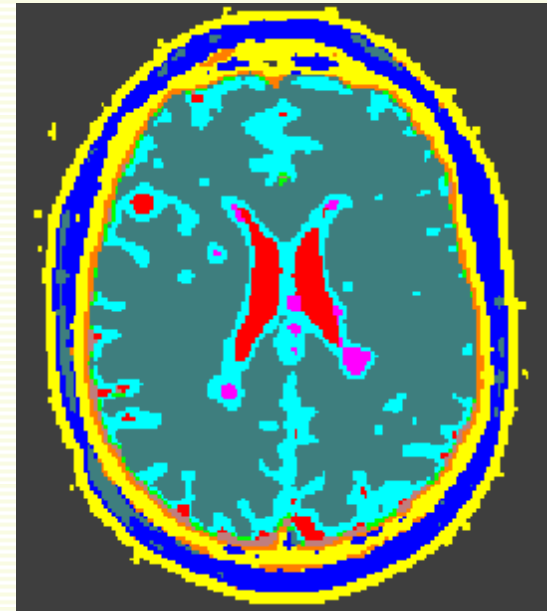


Synthetic rendering

CV Application: Medical Image Segmentation



segmentation
→



M. Leventon

CV Application: Digital Libraries

- Data Base extenders for media data management
- Server based
- CBIR
 - IBM QBIC
 - Virage, etc.
- Good for Ad professional
 - Similarity for fade, wipe, etc
- Consumers want
 - “just find it”
 - Natural user interface



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Summary

- Brief introduction to three very active and exciting areas of AI
 - Machine Learning (ML)
 - Natural Language Processing (NLP)
 - Computer Vision (CV)
- Each programming assignment will focus on developing a practical application in each of these areas