

(Q) Describe: ...

SCC361: Artificial Intelligence
Week 1: Introduction to Artificial Intelligence and Machine Learning
Dr Bryan M. Williams
School of Computing and Communications, Lancaster University
Office: InfoLab21 C40 Email: b.williams6@lancaster.ac.uk

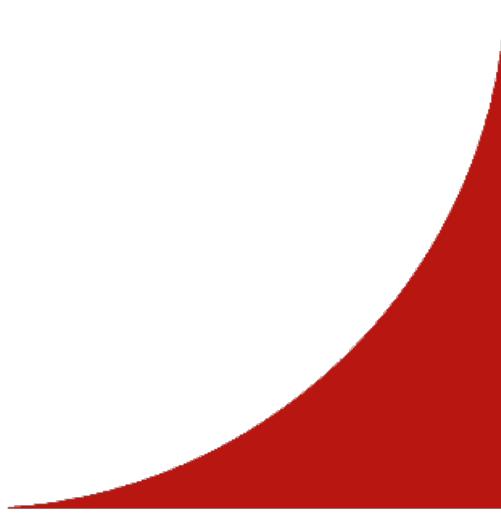


(Q) Describe: SCC361: Artificial Intelligence

1 SCC361: Artificial Intelligence

2

Lectures, Materials and Expectations
Introduction to the Module
Overview of Artificial Intelligence
Overview of Machine Learning



Lectures, Materials and Expectations

Introduction to the Module

Overview of Artificial Intelligence

Overview of Machine Learning

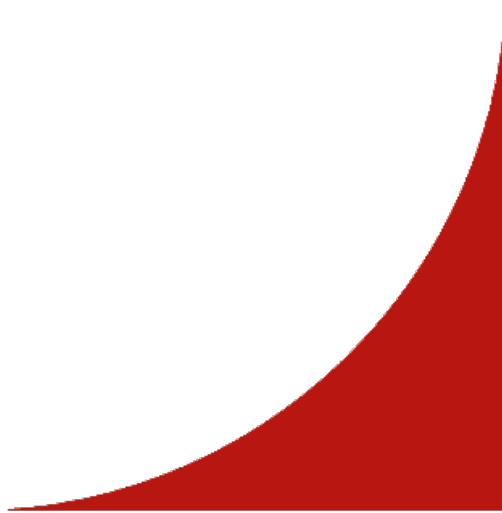


(Q) Describe: Playing this Video

2 Playing this Video

- This version is unedited
 - In general, it might be slow for some people
 - Vary the playback speed to suit your preferred pace
 - In live sessions, you can ask questions at any stage, but the Questions? slides will give you a specific opportunity to ask questions
- While watching, use the Questions? slides as stop points for coffee breaks, notes etc

3



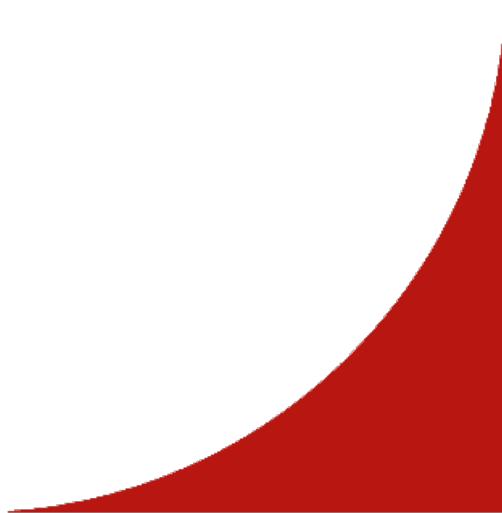


(Q) Describe: Accessibility

3 Accessibility

- All our content is expected to meet the UK accessibility requirements
- We have done our best to ensure that that is the case with these course materials
- However, if any course material or part of its content is inaccessible in anyway to any individual or group, kindly let us know.

4





(Q) Describe: Be sure to check in to all timetabled sessions using

4 Be sure to check in to all timetabled sessions using

Attendance Check-in

To check in:

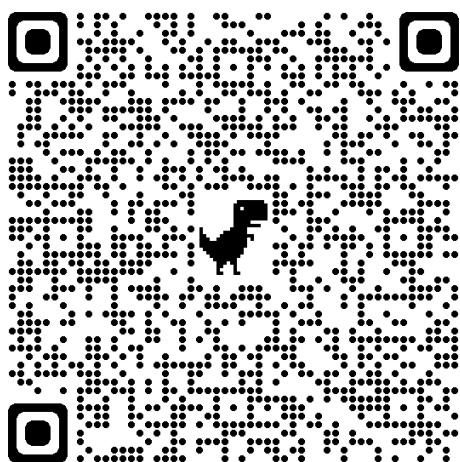
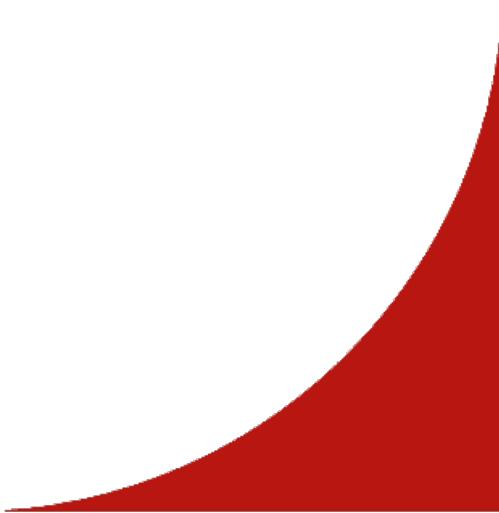
- Check the Attendance Hub in iLancaster
- Click Check In
- Wait for the “You are checked in” confirmation page
- Here is a the demo

Please DO NOT leave a timetabled session without your attendance being registered

Attendance Check-in

5





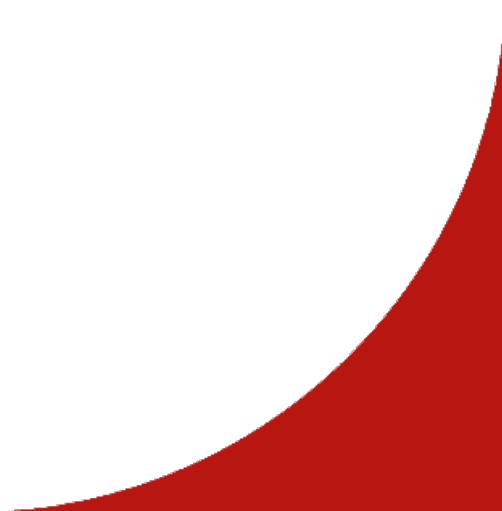
(Q) Describe: Online Sessions on Teams

5 Online Sessions on Teams

Before the session:

- Follow the Moodle link to join the lecture
- Ensure that your speakers, headsets are connected and working

6



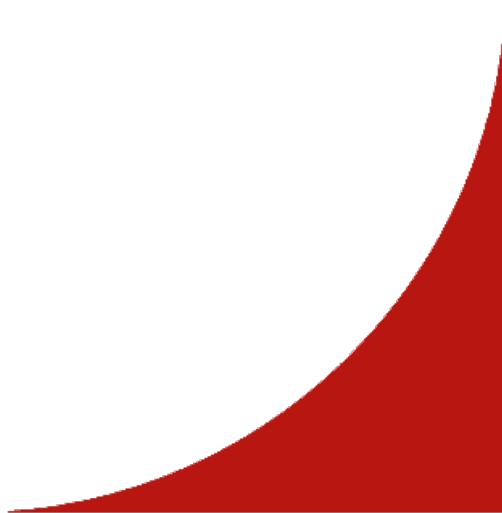
(Q) Describe: Online Sessions on Teams

6 Online Sessions on Teams

During the lectures:

- Turn your webcam off
- Turn your microphone off

7



(Q) Describe: Online Sessions on Teams

7 Online Sessions on Teams

During the lectures:

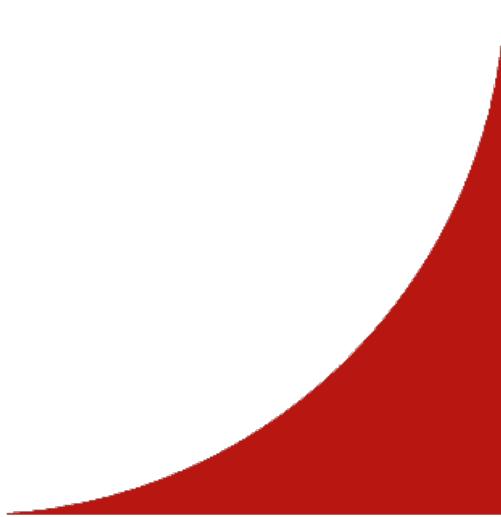
- Use chat appropriately. Not closely monitored during lectures.

For live Q&A sessions:

- Raise your hand to ask questions. Lower it afterwards.
- When called, turn on your mic (and cam if you wish). Remember to turn them off afterwards.

Post additional questions on the SCC361 Moodle Forum

8





(Q) Describe: Online Sessions on Teams

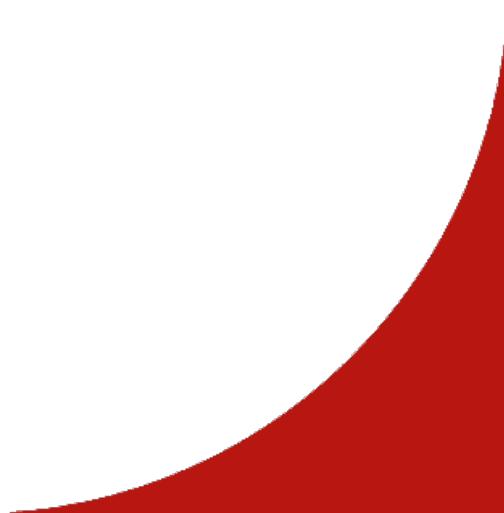
8 Online Sessions on Teams

After the lectures:

- The recorded content of the live sessions will be made available after the session on the

Moodle Space

9



(Q) Describe: The lectures can be watched on the Moodle space.

9 The lectures can be watched on the Moodle space.

If you are struggling to watch the videos on Moodle:

- Download the video and caption file (*.vtt) from Moodle
- Download the free, open source VLC Media player:

<https://www.videolan.org/vlc/index.en-GB.html>

- Open video file in VLC and add caption file

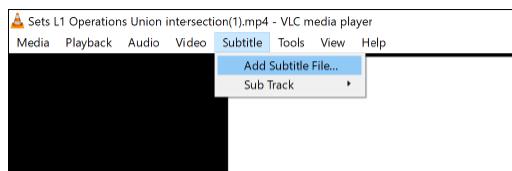
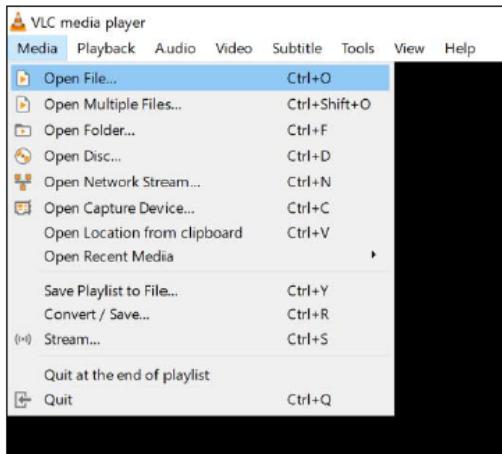
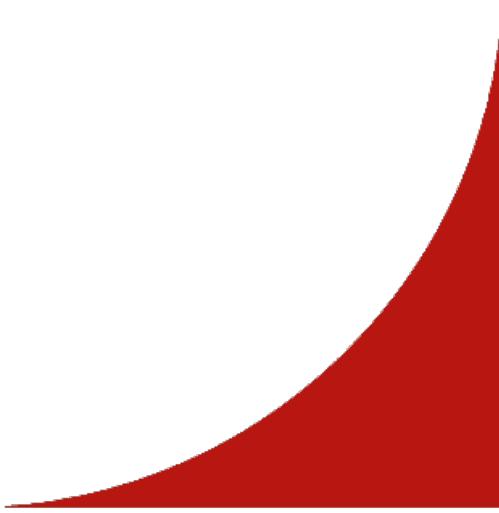
Note:

All learning materials: slides, videos and caption files are @Lancaster University copyright and are not to be shared or distributed.

Using Materials Offline

10





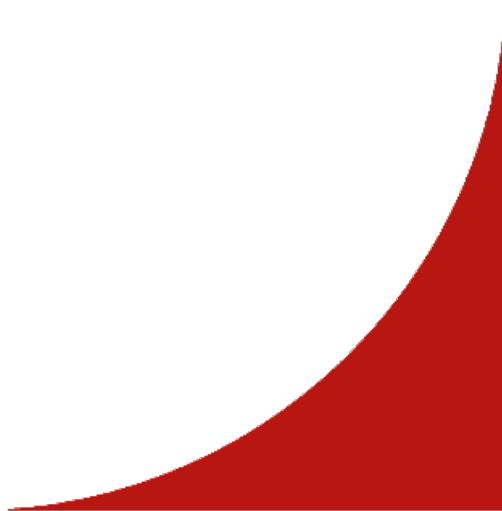
(Q) Describe: Passing off someone else's work as your own, including:

10 Passing off someone else's work as your own, including:

- Colluding with a classmate or someone else to do your work
- Submitting code written by someone else
- Paying for someone else to do your work
- Adapting code by someone else with only a minor modification
- Course work is submitted on Moodle and will be checked automatically for plagiarism!

Plagiarism

11



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(Q) Describe: Online tools will be used to facilitate some aspects of learning e.g. Moodle, Teams, etc.

11 Online tools will be used to facilitate some aspects of learning e.g. Moodle, Teams, etc.

- The use of these is governed by existing policies that you are all currently bound by and

have agreed to

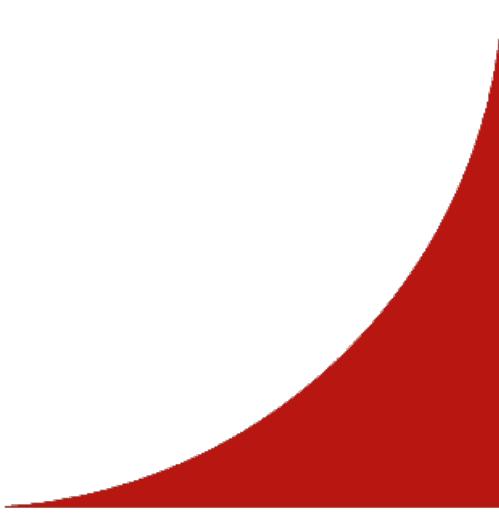
- Academic malpractice and plagiarism still applies online
- Direct sharing of code, sharing solutions and/or partial solutions with other students,

either privately or in an open chat, is not acceptable

Online Learning Expectations

12





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(Q) Describe: Don't forget, these are your fellow students and staff,
not some anonymous person on

12 Don't forget, these are your fellow students and staff, not some anonymous person on

the Internet

- If you're not sure if you should post or share something, please ask first
- If you see content or a post that you don't like, in the first instance, message or email

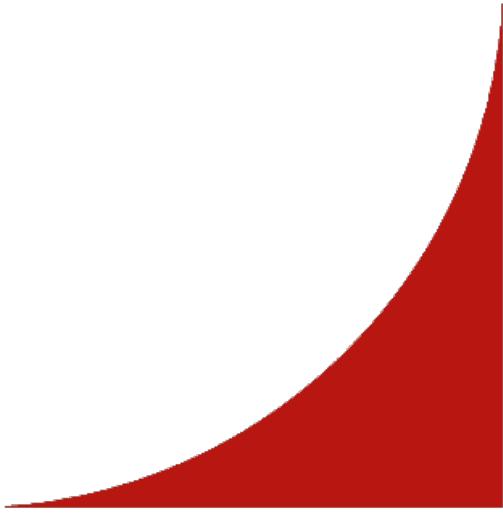
the course tutor to alert them to it

- We want these tools to be used; they will give you the best online experience!
- However, we are asking that you use them sensibly and with respect

Online Learning Expectations

13





(Q) Describe: Attendance:

13 Attendance:

- Lectures, labs etc., be punctual

Active learning:

- Read around (explore) the subject
- Use recommended books and available online resources
- Ask questions, try things yourself, keep notes
- Have a study plan, get a study partner

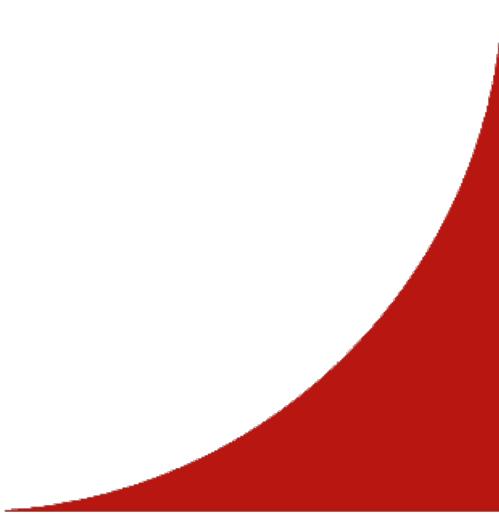
Integrity:

- Honesty, no plagiarism/ result manipulation

What do we expect from you?

14





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(Q) Describe: Lecture slides and videos will be available on Moodle

14 Lecture slides and videos will be available on Moodle

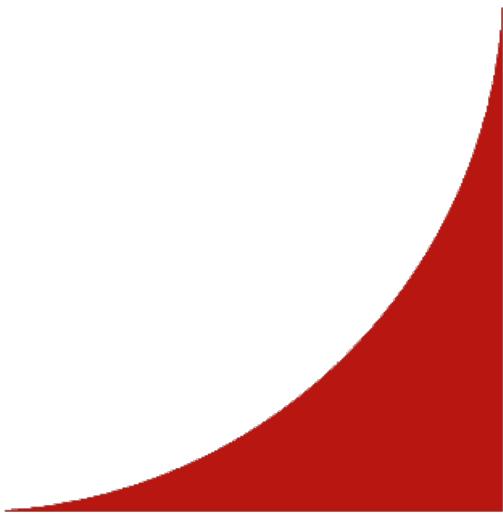
- Provide references to follow up
- TAs will be available to ensure that the labs are running smoothly
- Arrange extra support if you are struggling and let us know on time
- Provide prompt feedback on formative coursework
- In extreme cases, respond to coursework questions outside the labs
- We encourage you to maximise the use of lab sessions for all coursework related

questions

How can we help?

15





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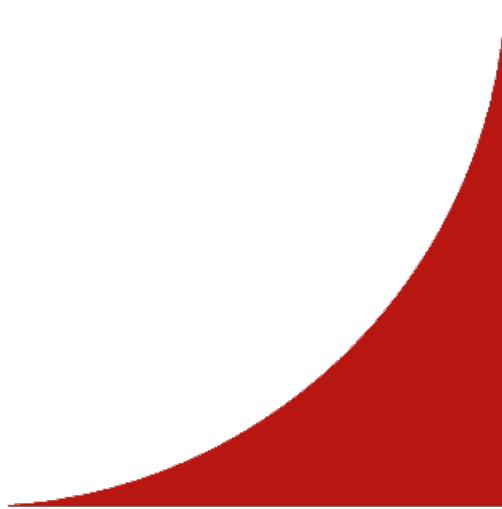
(Q) Describe: Use the labs to ask TAs/Tutors for help

15 Use the labs to ask TAs/Tutors for help

- Use the course forum on Moodle
- Check other available (online) resources
- Drop me an email/ ask on Teams chat
- There might be delays in replying

How to get help

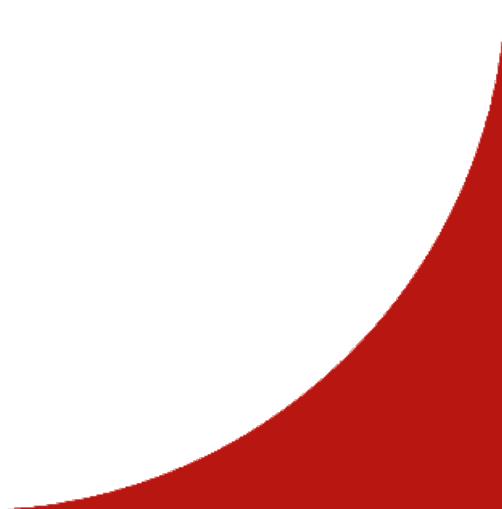
16



(Q) Describe: Questions?

16 Questions?

17



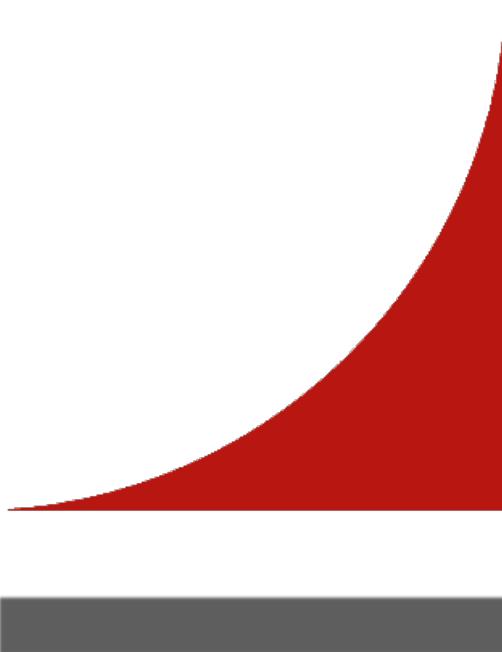


(Q) Describe: SCC361: Artificial Intelligence

17 SCC361: Artificial Intelligence

18

Lectures, Materials and Expectations
Introduction to the Module
Overview of Artificial Intelligence
Overview of Machine Learning



Lectures, Materials and Expectations



Introduction to the Module

Overview of Artificial Intelligence

Overview of Machine Learning

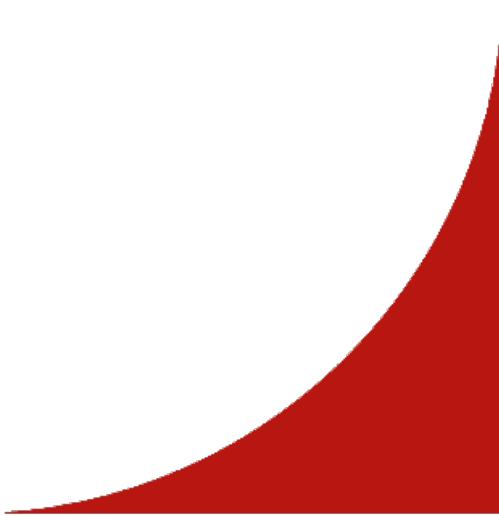


(Q) Describe: In this video

18 In this video

- Expected Learning Outcomes
- Teaching Staff
- Lecture Plan
- Teaching Structure
- Assessment

19





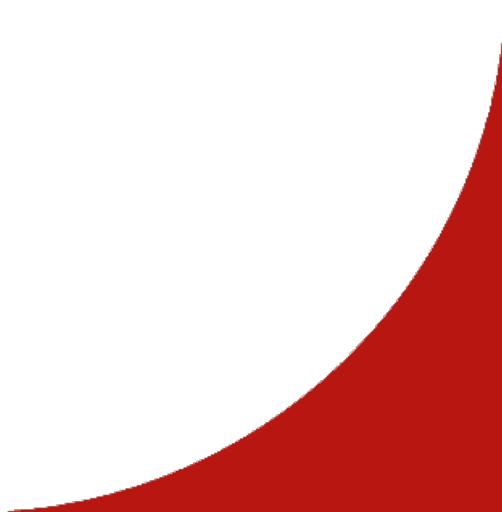
(Q) Describe: Expected Learning Outcomes

19 Expected Learning Outcomes

We will be able to:

- understand AI concepts, applications and trends
- understand machine learning terms
- train machine learning models for specific tasks
- learn implement simple AI-based systems
- learn how to evaluate the performance of AI systems

20





(Q) Describe: Teaching Staff

20 Teaching Staff

21

Dr Bryan M. Williams

Weeks 1-5

Dr Hossein Rahmani

Weeks 6-10

Module Convenor

Teaching Assistants Group 1 Group 2 Group 3 Group 4 Group 5

Mona Alghamdi

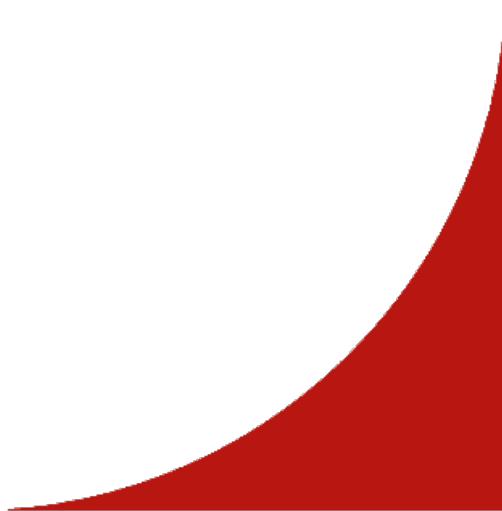
Somayeh Bazin

Piotr Daniszewski

Oishi Deb

Ovini Gunasekera

Yuri Tavares dos Passos





(Q) Describe: Lecture Plan

21 Lecture Plan

Weeks 1-5

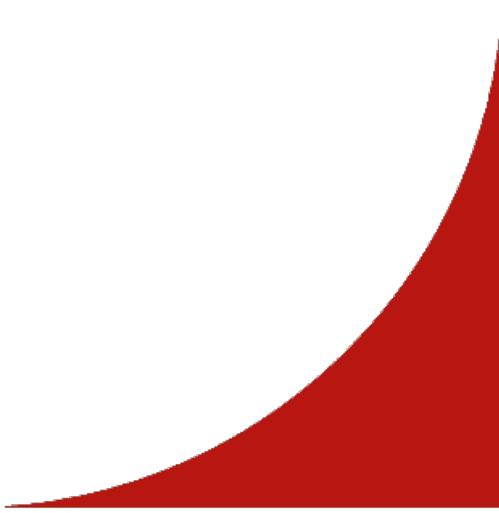
1. Introduction to Artificial Intelligence and Machine Learning
2. Features in Machine Learning and Feature Extraction
3. Computer Vision and Natural Language Processing
4. Clustering and Classification
5. Artificial Neural Networks

Weeks 6-10:

6. Genetic Algorithms
7. Naïve Bayesian Classifier
8. Decision Tree Classifier
9. Introduction to Deep Neural Networks
10. Introduction to Convolutional Neural Networks

22





(Q) Describe: Teaching Structure

22 Teaching Structure

Lectures:

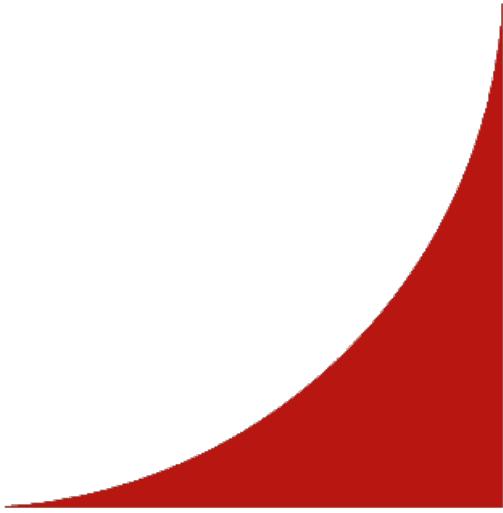
- Weeks 1-10
- Online only
- Mondays: 14.00-15.00
- Tuesdays: 17.00-18.00

Labs:

- Weeks 1-10
- Blended: in-person and online
- Wednesdays: 11.00-13.00
- Thursdays: 10.00-12.00
- Thursdays: 16.00-18.00
- Fridays: 11.00-13.00
- Fridays: 16.00-18.00

23





(Q) Describe: Teaching Structure

23 Teaching Structure

Labs:

24

Group Day Time Room

SCC361/P01/01 Wednesday 11:00-13:00 FST B076

SCC361/P01/02 Thursday 16:00-18:00 FST B076

SCC361/P01/03 Friday 16:00-18:00 (Weeks 1-4, 6, 8, 10)

14:00-16:00 (Weeks 5, 7, 9)

FST B070 (Weeks 1-4)

FST B074 (Weeks 5, 7, 9)

FST B080 (Weeks 6, 8, 10)

SCC361/P01/04 Thursday 10:00-12:00 FST B070

SCC361/P01/05 Friday 11:00-13:00 FST B080



(Q) Describe: 2 Courseworks: 40%

24 2 Courseworks: 40%

- CW1 (20marks):
 - Submission: On Moodle
 - Deadline: 5pm Friday 12th November, 2021
- CW2 (20marks):
 - Details: to be confirmed

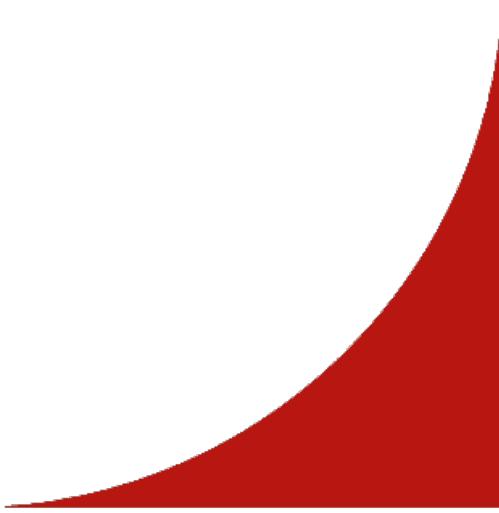
Exam: 60%

- Next semester in 2021
- Date: To be confirmed

Assessment

25

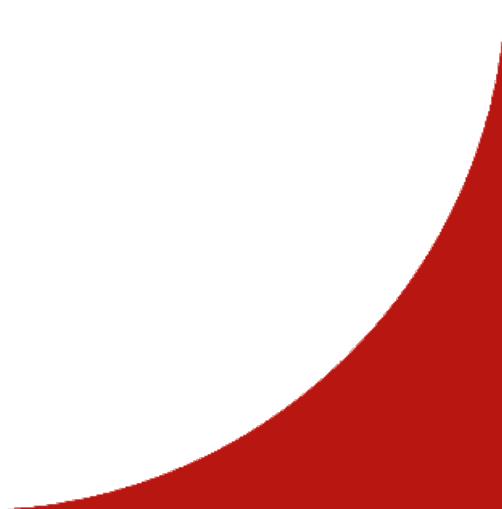




(Q) Describe: Questions?

25 Questions?

26



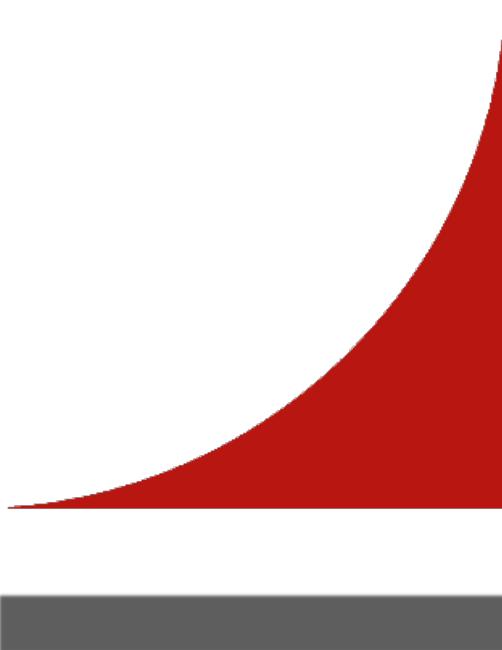


(Q) Describe: SCC361: Artificial Intelligence

26 SCC361: Artificial Intelligence

27

Lectures, Materials and Expectations
Introduction to the Module
Overview of Artificial Intelligence
Overview of Machine Learning



Lectures, Materials and Expectations



Introduction to the Module

Overview of Artificial Intelligence

Overview of Machine Learning



(Q) Describe: Part 1 (Weeks 1 – 5):

27 Part 1 (Weeks 1 – 5):

- Wk1: Intro to Artificial Intelligence & Machine Learning
- Wk2: What are features and how to extract features from texts, images, etc.
- Wk3: Computer Vision and Natural Language Processing
- Wk4: Clustering & Classification
- Wk5: Intro to Artificial Neural Networks & Review of Previous Lectures

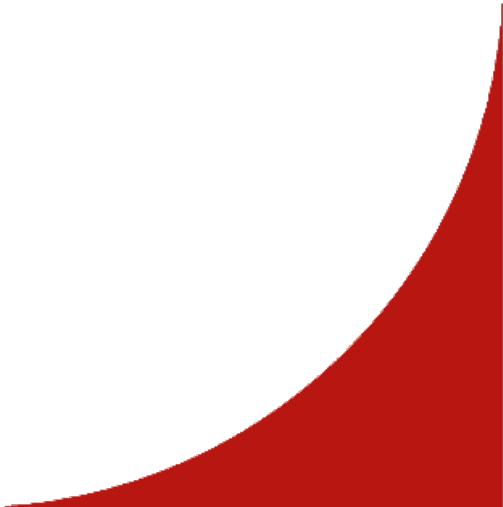
Part 2 (Weeks 6 – 10):

- Dr Hossein Rahmani (GAs, NBCs, DTCs, DNNs, CNNs)

Welcome to SCC361

28





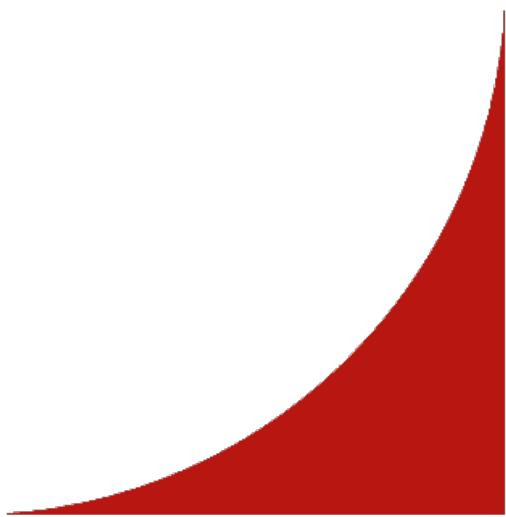
(Q) Describe: Artificial Intelligence: An Overview

28 Artificial Intelligence: An Overview

- Application, history, foundations of AI
- Definition of AI
- Goals of AI
- AI and the Society
- Benefits
- Risk and Challenges
- Ethical Issues

This Week's Lectures

29





(Q) Describe: Overview of Machine Learning

29 Overview of Machine Learning

- AI and ML, Definitions of ML, How to learn

Types of Machine Learning

- Supervised, unsupervised, semi supervised

Supervised Learning

- Classification and regression

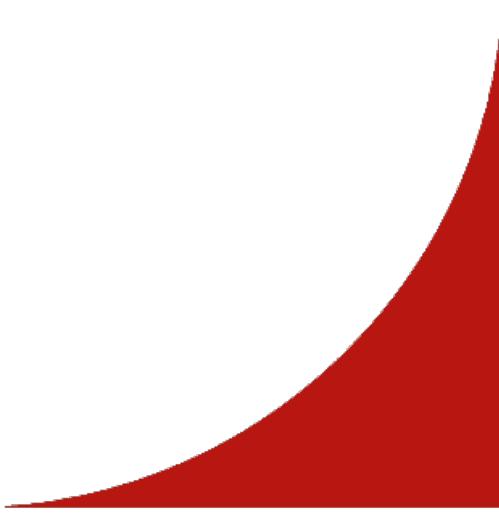
Unsupervised Learning

- Clustering and association

This Week's Lectures

30





(Q) Describe: Artificial Intelligence: Foundations of Computational

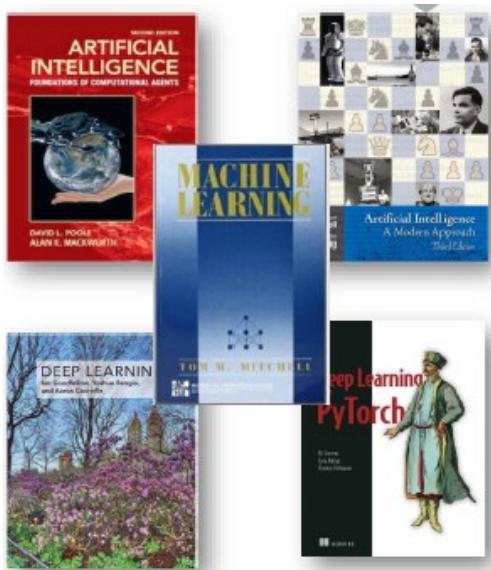
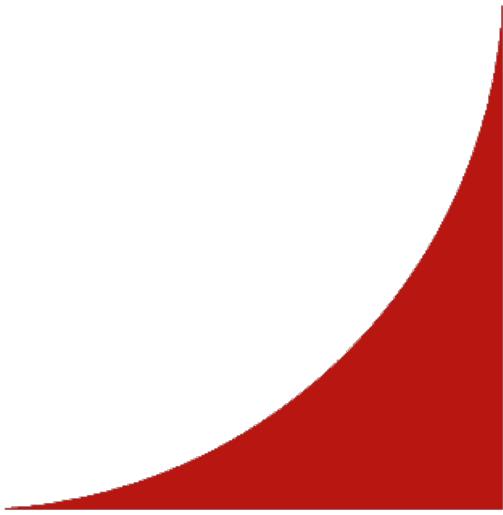
30 Artificial Intelligence: Foundations of Computational

Agents 2ed. Poole & Mackworth 2017

- Artificial Intelligence A Modern Approach, Russell & Norvig, 2016 (chapters 1,2,5,6)
- Deep Learning, Goodfellow et al. , 2016
- Deep Learning with PyTorch, Stevens et al, 2020.
- Machine Learning, T. M. Mitchell, 1997
- Artificial Intelligence on Wikipedia
- Many online resources

Recommended Reading
31





(Q) Describe: SCC361: Week 1

31 SCC361: Week 1

32

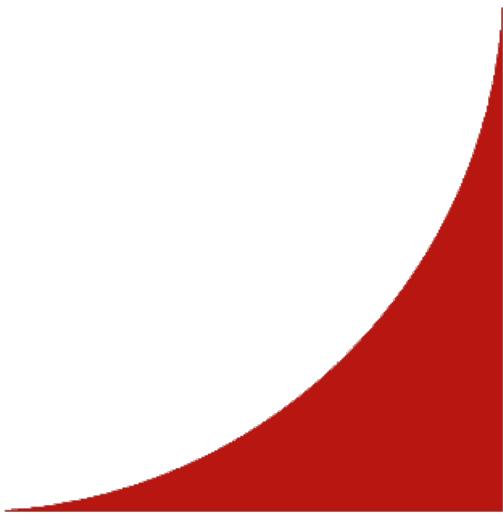
- AI Overview
- Definition of AI
- Goals of AI
- AI and Society

Artificial Intelligence

- Machine Learning Overview
- Types of Machine Learning
- Supervised Learning
- Unsupervised Learning

Introduction to Machine Learning

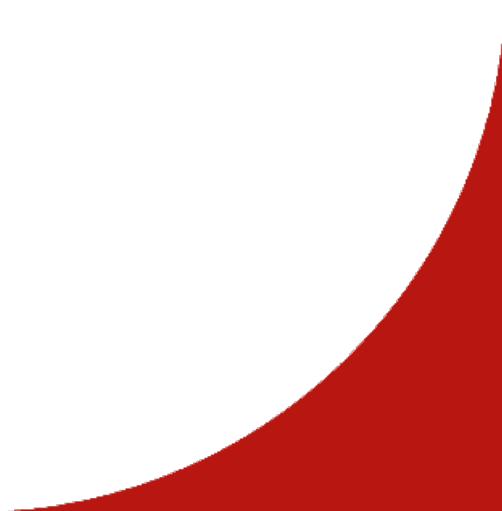




(Q) Describe: AI in Real Life

32 AI in Real Life

33



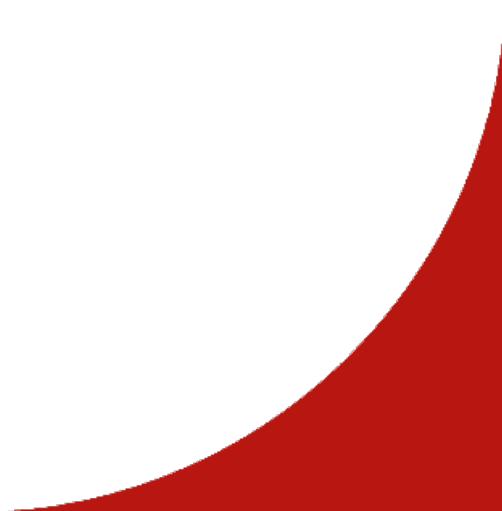




(Q) Describe: AI in Science Fiction Movies

33 AI in Science Fiction Movies

34





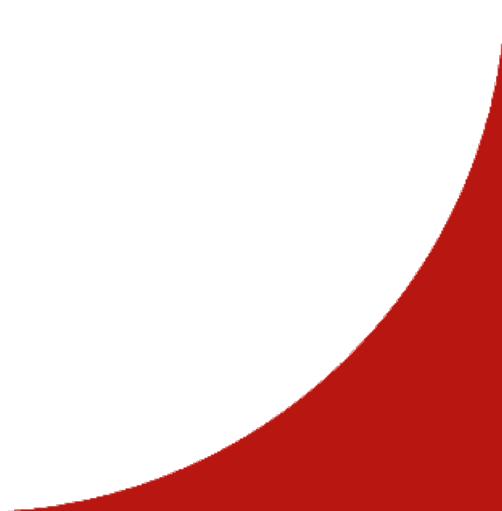




(Q) Describe: AI in Science Fiction Movies

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35



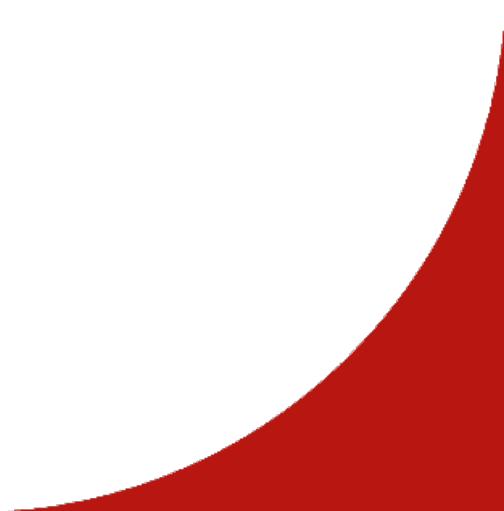




(Q) Describe: AI in Music

35 AI in Music

36

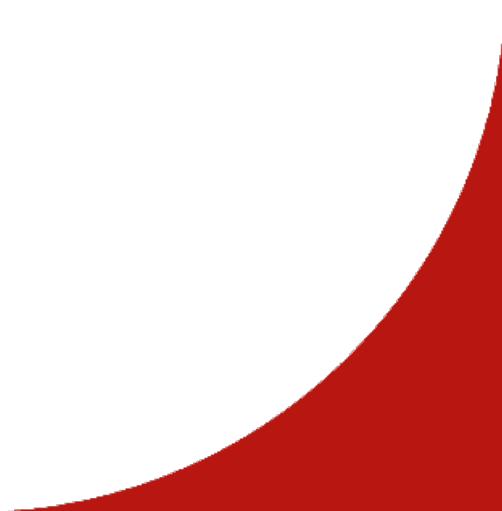




(Q) Describe: AI in Agriculture

36 AI in Agriculture

37



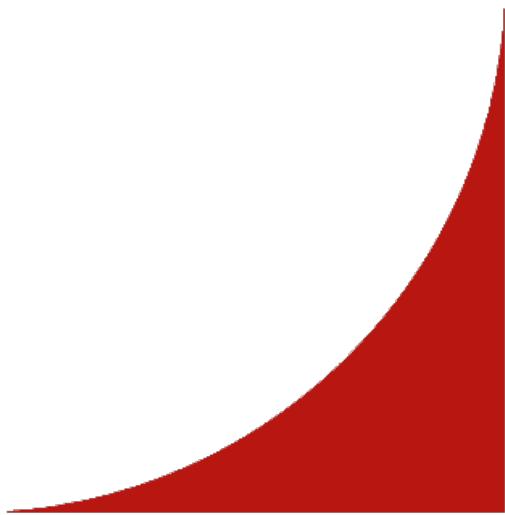
108



(Q) Describe: AI in Delivery Services

37 AI in Delivery Services

38

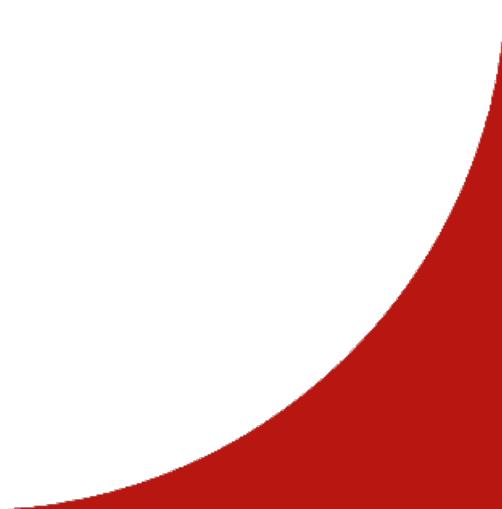




(Q) Describe: AI in Self-Driving Vehicles

38 AI in Self-Driving Vehicles

39

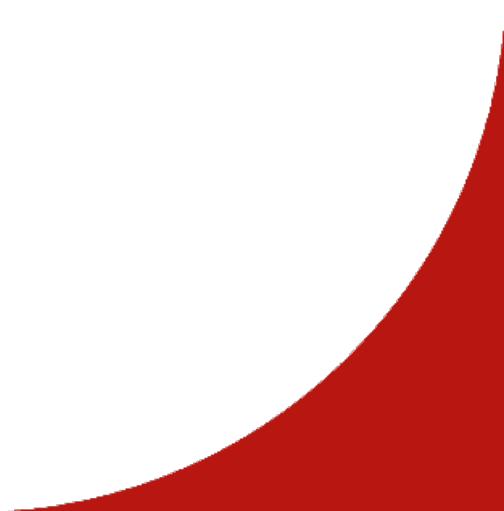




(Q) Describe: AI in Medicine

39 AI in Medicine

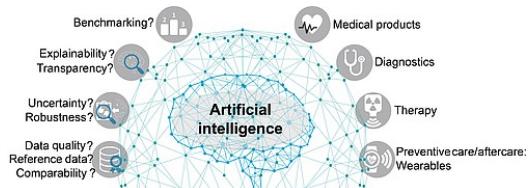
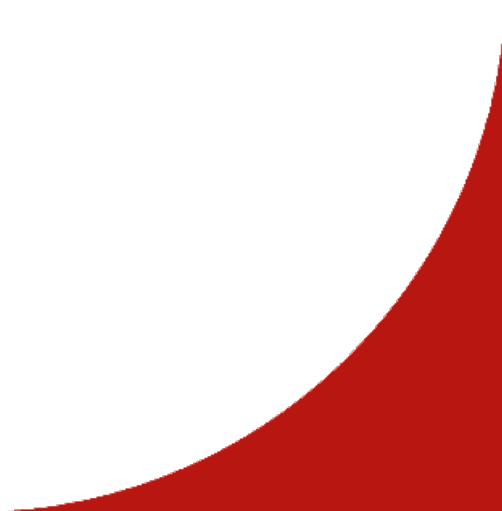
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(Q) Describe: AI in Medicine

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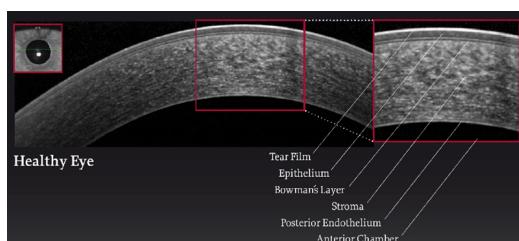
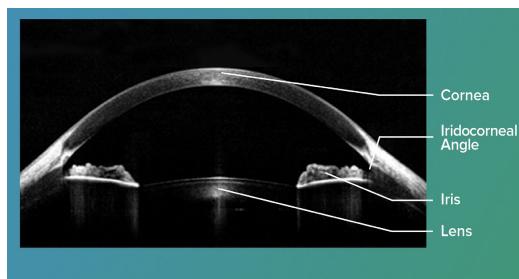
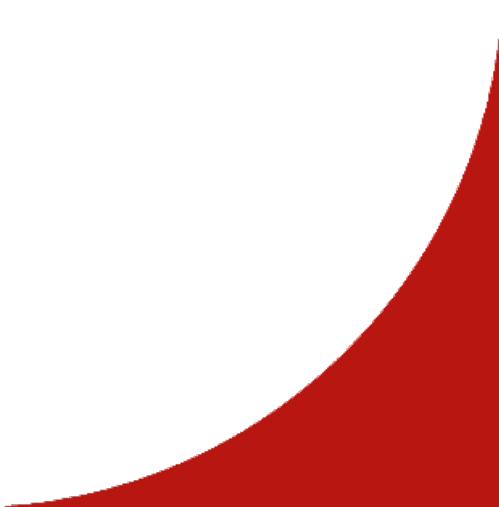
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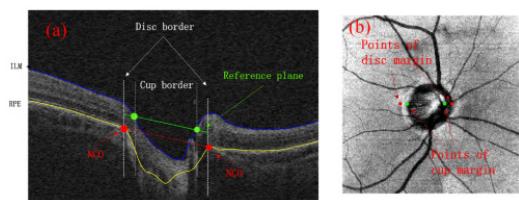
(Q) Describe: AI in Medicine

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42



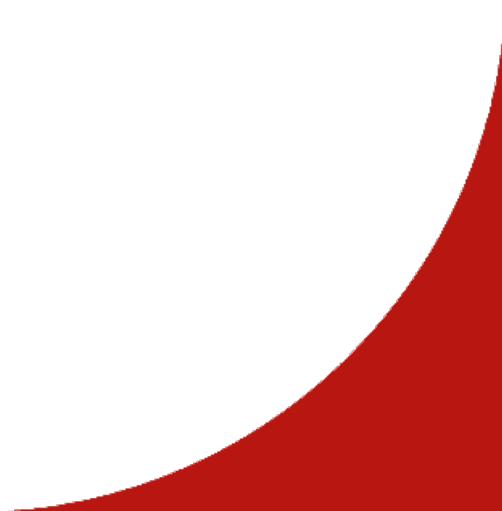


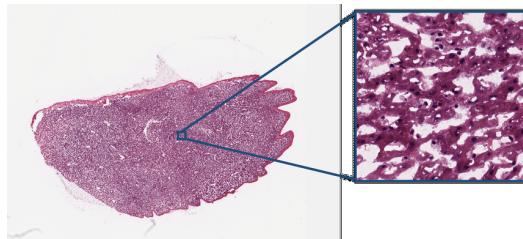
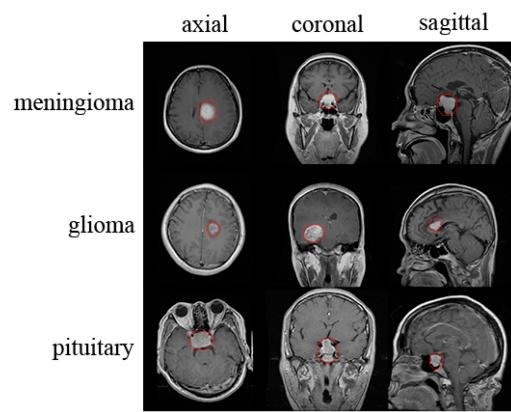


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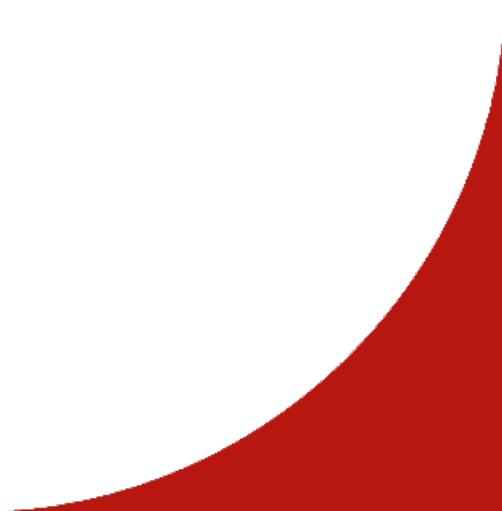


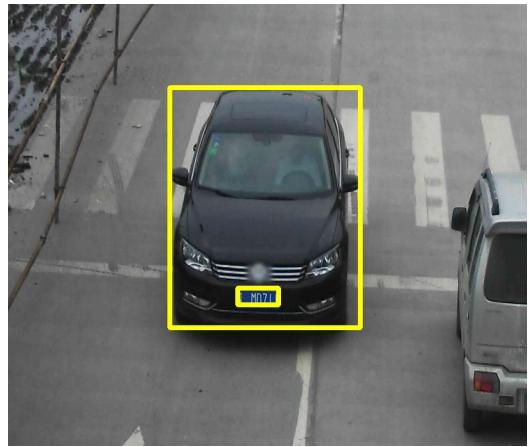


(Q) Describe: AI in Security

43 AI in Security

44



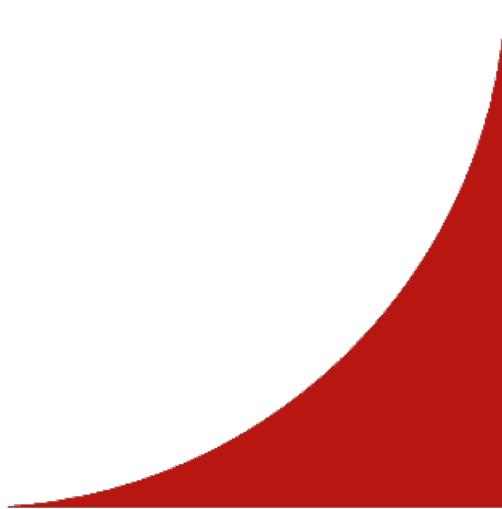


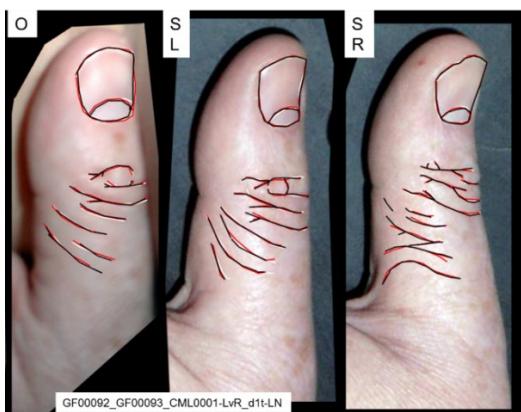
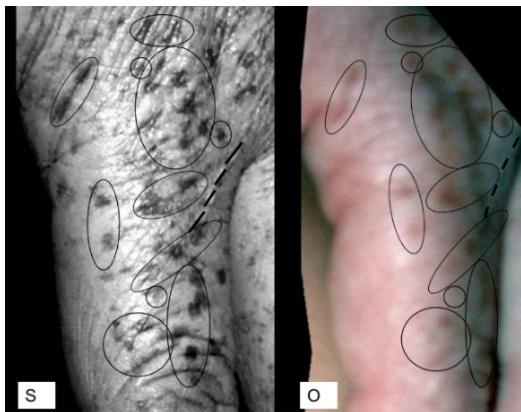
(Q) Describe: AI in Forensic Identification

44 AI in Forensic Identification

45

<https://h-unique.lancaster.ac.uk/>







H-Unique



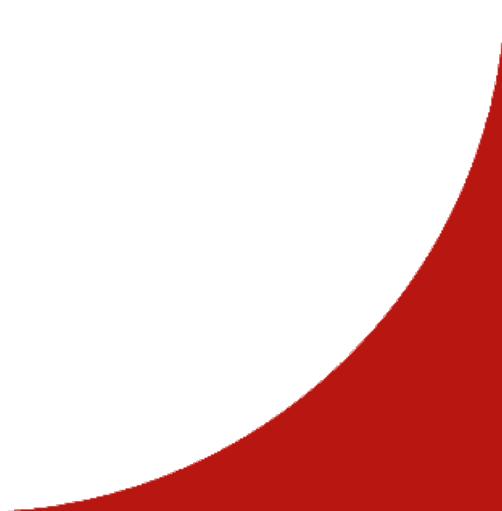
(Q) Describe: Web search engines

45 Web search engines

- Text classification: sentiment, topic
- Spam filtering etc
- Machine translation
- Question answering
- Recommender Systems

AI in Natural Language Processing

46



"Il est impossible aux journalistes de rentrer dans les régions tibétaines"

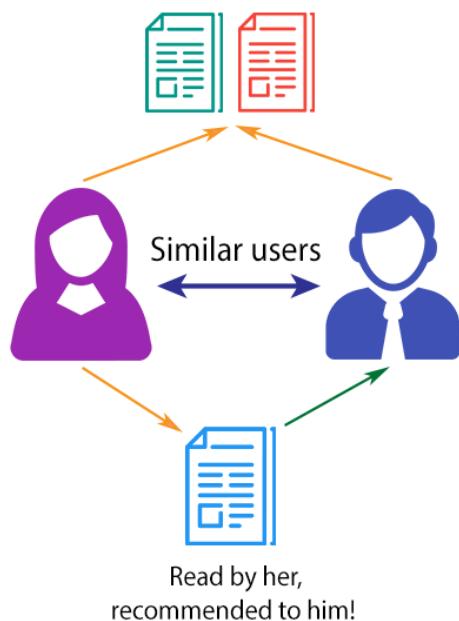
Bruno Philip, correspondant du "Monde" en Chine, estime que les journalistes de l'AFP qui ont été expulsés de la province tibétaine du Qinghai "n'étaient pas dans l'illégalité".

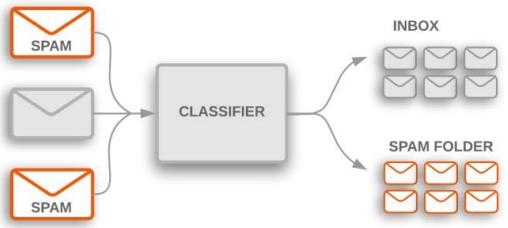
Les faits Le dalaï-lama dénonce l'"enfer" imposé au Tibet depuis sa fuite, en 1959

Vidéo Anniversaire de la rébellion tibétaine : La Chine ouvre ses portes



Read by both users





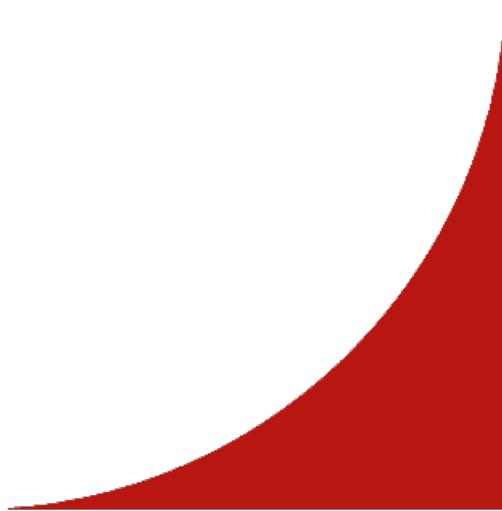
(Q) Describe: Speech Technologies

46 Speech Technologies

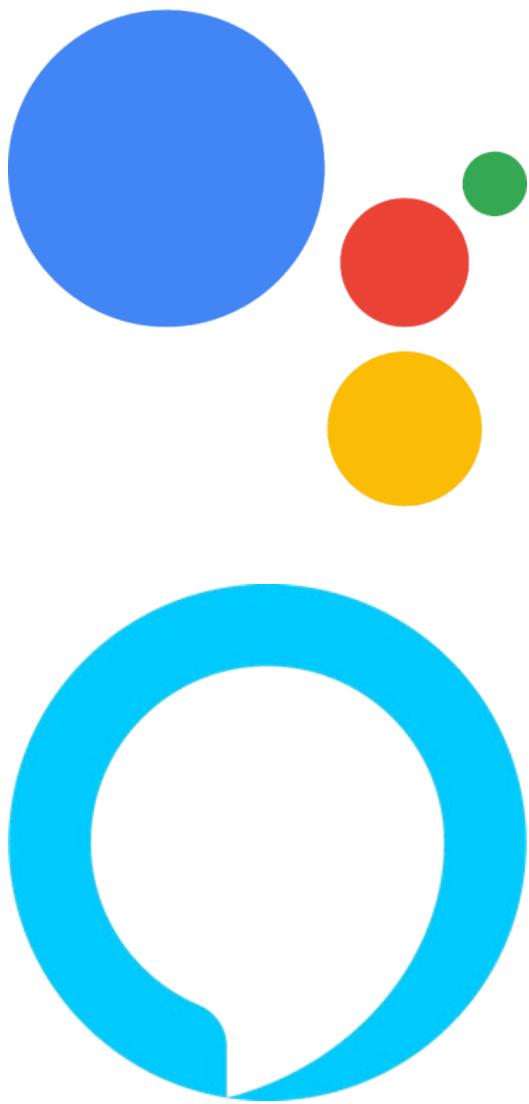
- Siri, Alexa, Cortana, Google Assistant
- Automatic Speech Recognition
- Dialogue systems

AI in Natural Language Processing

47







(Q) Describe: Brief History of AI

47 Brief History of AI

48

1940-1950: Early Days

- 1943: McCulloch & Pitts:

Boolean Circuit Model of
Brain

- 1950: Turing's "Computing

Machinery and
Intelligence"

1950-1970: Excitement

- 1950s: Early AI programs:

Samuel's checkers
program, Newell &
Simon's Logic Theorist,
Gelernter's Geometry
Engine

- 1956: Dartmouth meeting:

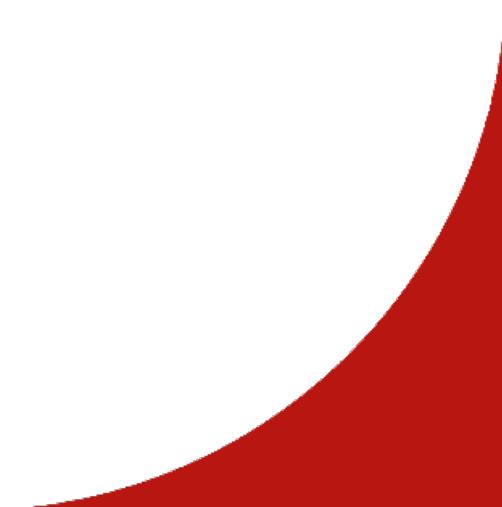
"Artificial Intelligence"
adopted

- 1965: Robinson's complete

algorithm for logical
reasoning

1970-1990: Knowledge-
based approaches

- 1969-79: Early development of knowledge-based systems
- 1980-88: Expert systems industry booms
- 1988-93: Expert systems industry busts: “AI Winter”
Lesson Notes from Nikita Kitaev, University of California, Berkeley



(Q) Describe: Brief History of AI

48 Brief History of AI

49

1990 – 2012:
Statistical approaches
+ subfield expertise:

- Resurgence of probability,

focus on uncertainty

- General increase in technical

depth

- Agents and machine learning

systems... “AI Spring”?

2012 – now:
Excitement:

- Big data, big compute, deep

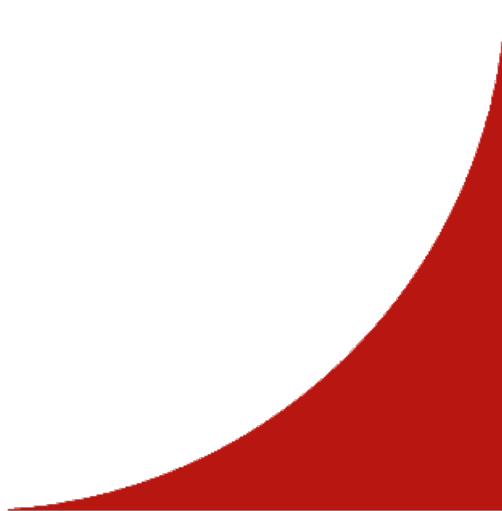
neural networks

- Some re-unification of

subfields

- AI used in many industries

Lesson Notes from Nikita Kitaev, University of California, Berkeley



(Q) Describe: Foundations of Artificial Intelligence

49 Foundations of Artificial Intelligence

50

Philosophy

Mathematics

Economics

Neuroscience

Psychology

Computer

engineering

Control

theory and

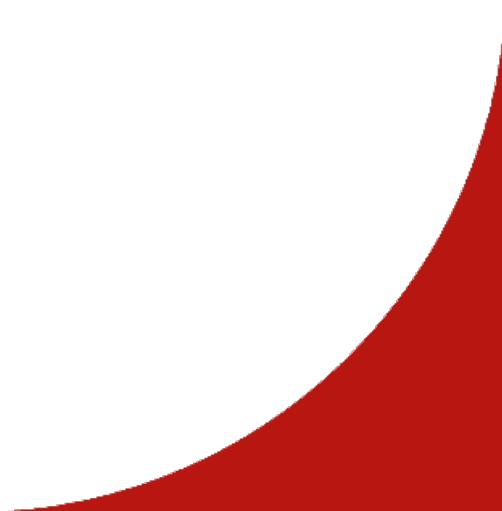
cybernetics



(Q) Describe: Questions?

50 Questions?

51





(Q) Describe: The Thinking Machine

51 The Thinking Machine

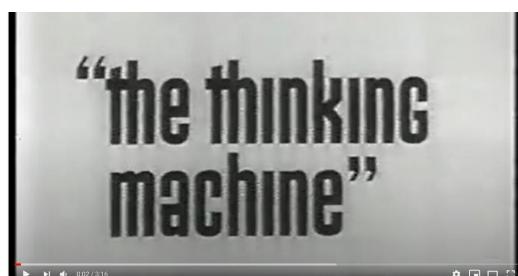
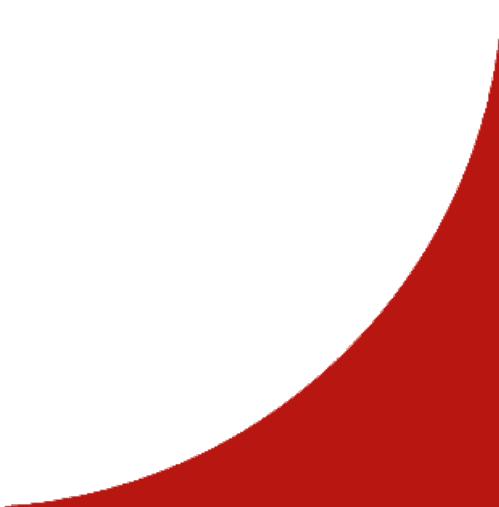
52

- Can machines really think?
- Interviews by some of the AI pioneers in the

1960s:

- Jerome Wiesner,
- Oliver Selfridge,
- Claude Shannon
- Can a robot marry my daughter?
- Can AI translate write poetry?

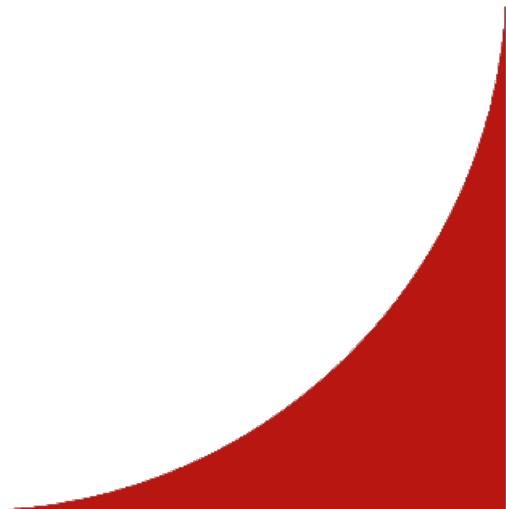




(Q) Describe: Human Intelligence

52 Human Intelligence

53



Learning



Reasoning



Perceiving



Understanding of Language



Feeling

(Q) Describe: Approach 1: Thinking Humanly

53 Approach 1: Thinking Humanly

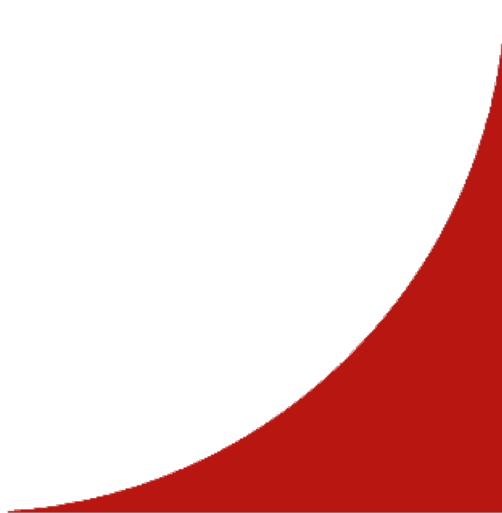
“The exciting new effort to make computers think ...machines with minds, in the full and literal sense.” (Haugeland, 1985)

- “[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning ...” (Bellman, 1978)

What is Artificial Intelligence?

54

Artificial Intelligence: A Modern Approach, 2016, Russell & Norvig

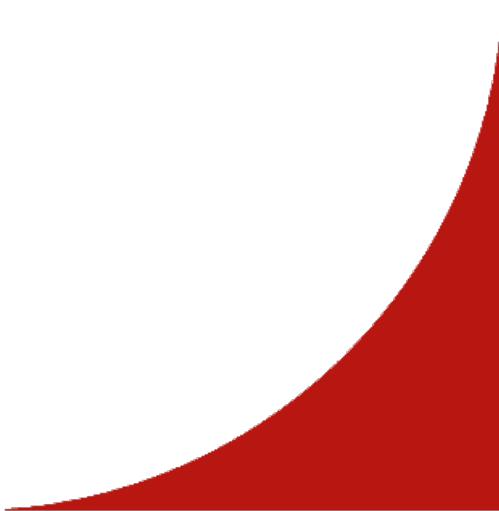


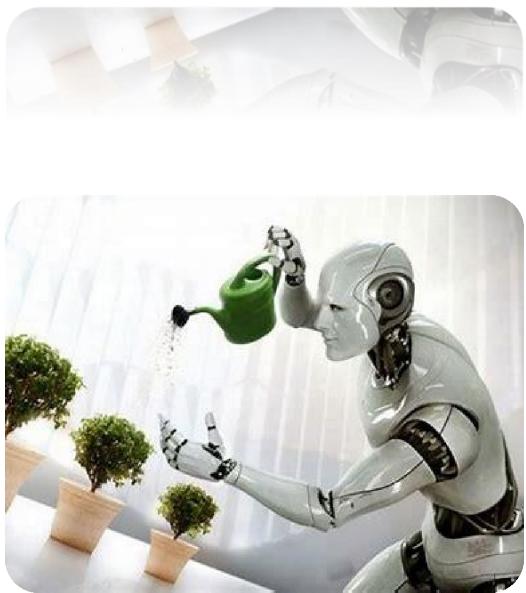


(Q) Describe: Approach 2: Acting Humanly

54 Approach 2: Acting Humanly

- “The art of creating machines that perform functions that require intelligence when performed by people.”
(Kurzweil, 1990)
- “The study of how to make computers do things at which, at the moment, people are better.” (Rich and Knight, 1991)
What is Artificial Intelligence?
55
Artificial Intelligence: A Modern Approach, 2016, Russell & Norvig

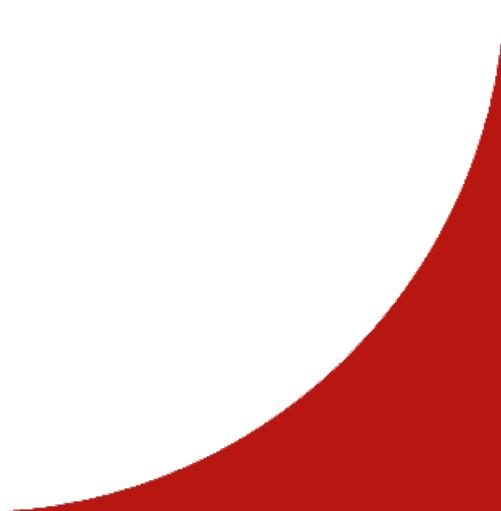


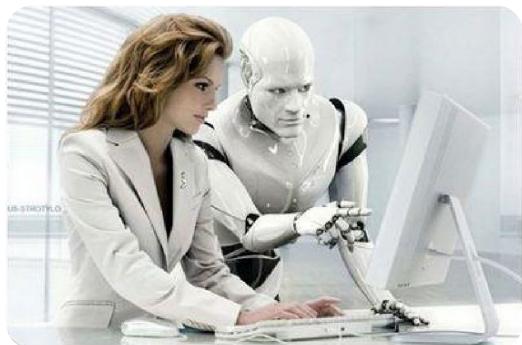


(Q) Describe: Approach 3: Thinking Rationally

55 Approach 3: Thinking Rationally

- “The study of mental faculties through the use of computational models.”
(Charniak and McDermott, 1985)
- “The study of the computations that make it possible to perceive, reason, and act.” (Winston, 1992)
What is Artificial Intelligence?
56
Artificial Intelligence: A Modern Approach, 2016, Russell & Norvig

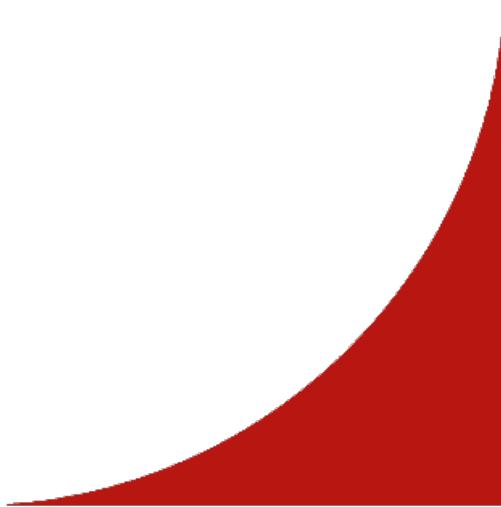




(Q) Describe: Approach 4: Acting Rationally

56 Approach 4: Acting Rationally

- “Computational Intelligence is the study of the design of intelligent agents.”
(Poole et al., 1998)
- “AI ... is concerned with intelligent behavior in artifacts.” (Nilsson, 1998)
What is Artificial Intelligence?
57
Artificial Intelligence: A Modern Approach, 2016, Russell & Norvig





(Q) Describe: Approaches to defining AI

57 Approaches to defining AI

58

Artificial Intelligence: A Modern Approach, 2016, Russell & Norvig
Human Rational

Thinking Systems that think like humans Systems that think rationally
Acting Systems that act like humans Systems that act rationally



(Q) Describe: Approaches to defining AI

58 Approaches to defining AI

59

Artificial Intelligence: A Modern Approach, 2016, Russell & Norvig
Human Rational
Thinking
Systems that think like humans

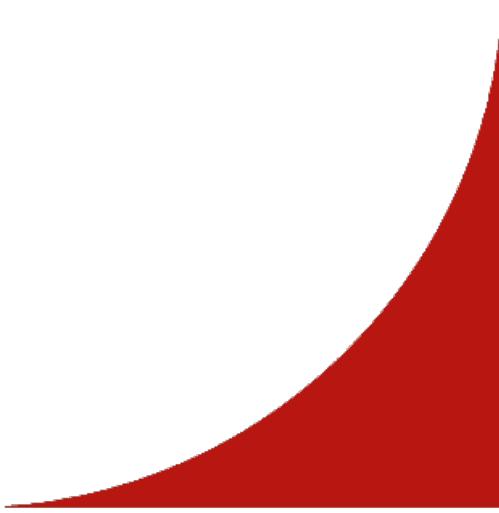
- Cognitive modelling approach
- Introspection, psychological

experiments, brain imaging

- Cognitive Science

Systems that think rationally
Acting Systems that act like humans Systems that act rationally





(Q) Describe: Approaches to defining AI

59 Approaches to defining AI

60

Artificial Intelligence: A Modern Approach, 2016, Russell & Norvig

Human Rational

Thinking

Systems that think like humans

- Cognitive modelling approach
- Introspection, psychological

experiments, brain imaging

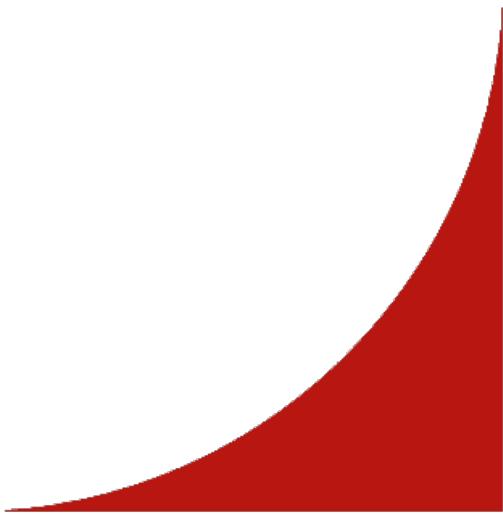
- Cognitive Science

Systems that think rationally

- Laws of thought approach
- “Logicist” tradition
- Mostly rule-based
- Logic

Acting Systems that act like humans Systems that act rationally





(Q) Describe: Approaches to defining AI

60 Approaches to defining AI

61

Artificial Intelligence: A Modern Approach, 2016, Russell & Norvig

Human Rational

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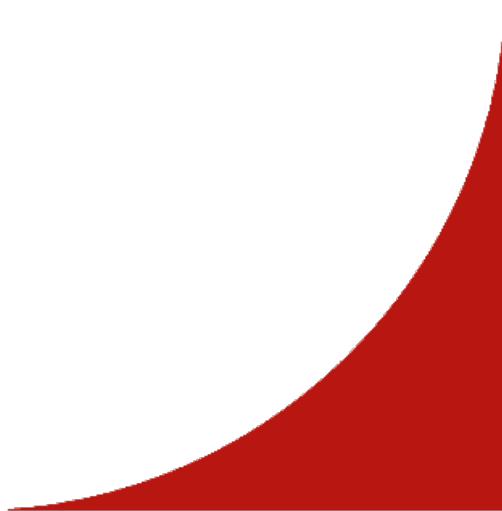
Acting

Systems that act like humans

- The (total) Turing Test
- Requires the 6 disciplines
- NLP, KR, Reasoning, ML,

Computer vision, Robotics

Systems that act rationally



(Q) Describe: Approaches to defining AI

61 Approaches to defining AI

62

Artificial Intelligence: A Modern Approach, 2016, Russell & Norvig

Human Rational

Thinking

Systems that think like humans

- Cognitive modelling approach
- Introspection, psychological

experiments, brain imaging

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- Laws of thought approach
- “Logicist” tradition
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Acting

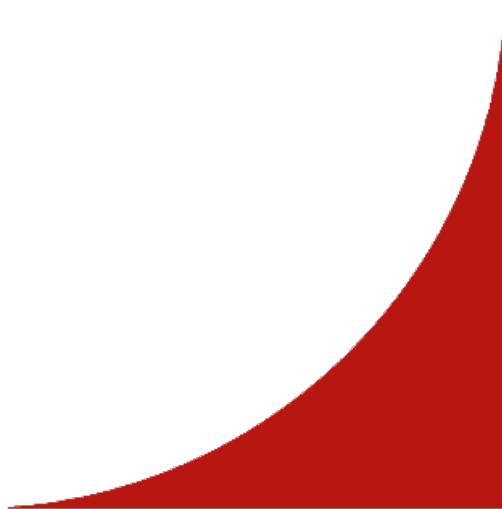
Systems that act like humans

- The (total) Turing Test
- Requires the 6 disciplines
- NLP, KR, Reasoning, ML,

Computer vision, Robotics

Systems that act rationally

- The rational agent approach
 - Autonomous, perceptive,
- persistent, adapts to change
- Creates and pursues goals



(Q) Describe: Approaches to defining AI

62 Approaches to defining AI

63

Artificial Intelligence: A Modern Approach, 2016, Russell & Norvig

Human Rational

Thinking

Systems that think like humans

Cognitive modelling approach

Introspection, psychological experiments, brain imaging

- Cognitive Science

Systems that think rationally

- Laws of thought approach
- “Logician” tradition
- Mostly rule-based
- Logic

Acting

Systems that act like humans

- The (total) Turing Test
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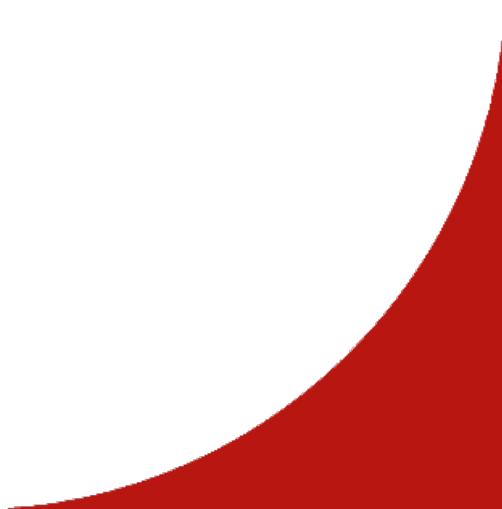
Computer vision, Robotics

Systems that act rationally

- The rational agent approach
- Autonomous, perceptive,

persistent, adapts to change

- Creates and pursues goals



(Q) Describe: An agent ‘acts’ (does something) within an environment

63 An agent ‘acts’ (does something) within an environment

e.g. worms, dogs, thermostats, airplanes, robots, humans, companies, and countries. An agent acts intelligently if:

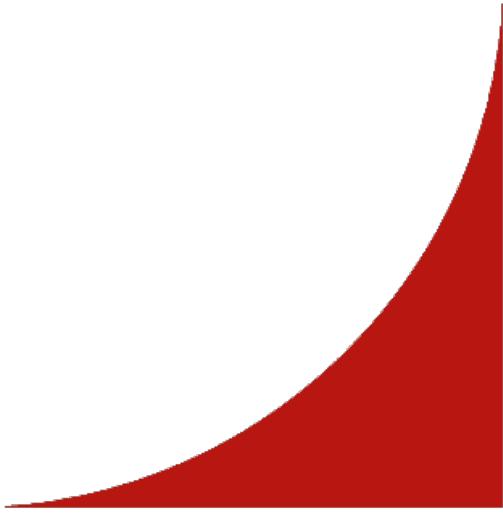
- action is appropriate for circumstances and goals
- flexible to changes in environment and goals
- learns from experience
- makes appropriate choices given perceptual and computational limitations

What is an Agent?

64

Artificial Intelligence: Foundations of Computational Agents, 2017, Poole & Markworth





(Q) Describe: A computational agent is:

64 A computational agent is:

- An agent whose decisions and actions can be explained in terms of computation.
- Decision can be broken down into primitive operations that can be implemented in a

physical device.

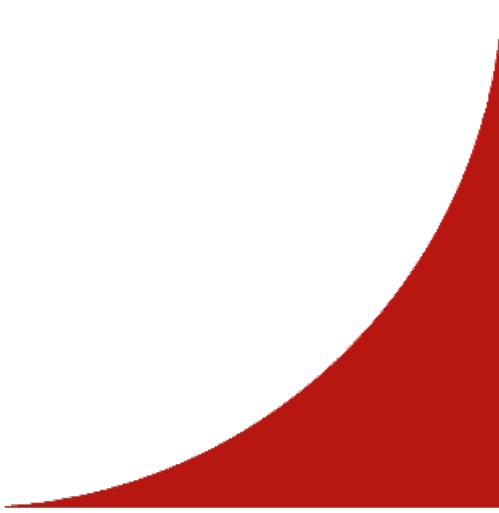
- Computations can take many forms
- The human brain (“wetware”)
- Computers (“hardware”)
- Non computational agents:
 - wind, rain, etc.

Computational Agent

65

Artificial Intelligence: Foundations of Computational Agents, 2017, Poole & Markworth





•

(Q) Describe: Rational agent acts to ‘achieve the best outcome or, when there is uncertainty, the

65 Rational agent acts to ‘achieve the best outcome or, when there is uncertainty, the

best expected outcome.’

- AI focuses on build the general principles of rational agent and components for constructing them

- Two key advantages of the rational-agent over others:
 - Amenable to scientific development than approaches on human thoughts and behaviour

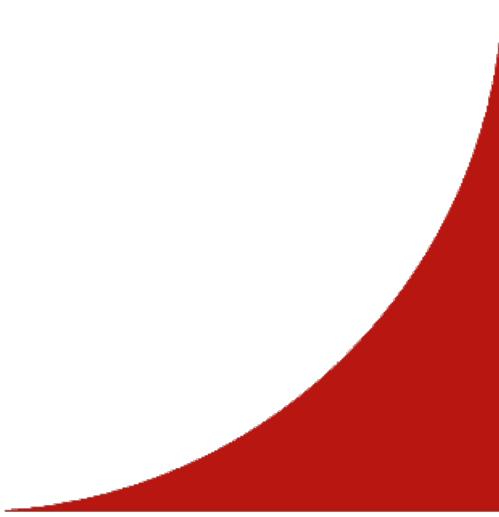
- It is more general than the “laws of thought” approach
- Also deals with limited rationality – acting appropriately with limited computations

Rational Agent

66

Artificial Intelligence: A Modern Approach, 2016, Russell & Norvig





•

(Q) Describe: AI is the field that studies the synthesis and analysis of computational agents that

66 AI is the field that studies the synthesis and analysis of computational agents that

act intelligently - Poole & Markworth

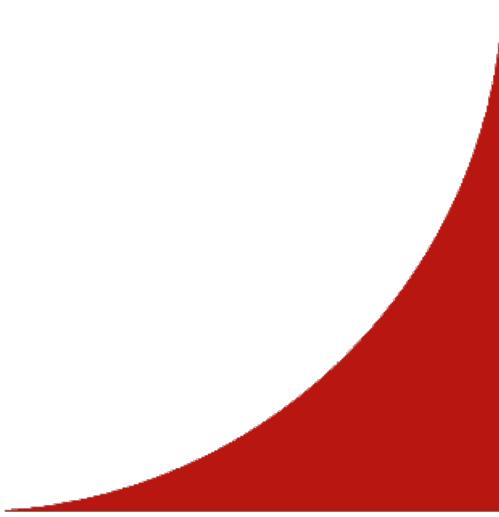
- An agent acts intelligently if:
- action is appropriate for circumstances and goals
- flexible to changes in environment and goals
- learns from experience
- makes appropriate choices given perceptual and computational limitations

Intelligence

67

Artificial Intelligence: Foundations of Computational Agents, 2017, Poole & Markworth





•

(Q) Describe: AI is the field that studies the synthesis and analysis of computational agents that

67 AI is the field that studies the synthesis and analysis of computational agents that

act intelligently - Poole & Markworth

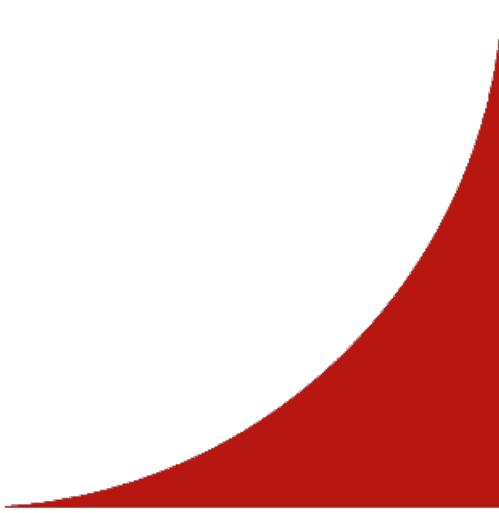
- An agent acts intelligently if:
- action is appropriate for circumstances and goals
- flexible to changes in environment and goals
- learns from experience
- makes appropriate choices given perceptual and computational limitations

Intelligence

68

Artificial Intelligence: Foundations of Computational Agents, 2017, Poole & Markworth





(Q) Describe: Artificial intelligence, or AI is the field that studies the

68 Artificial intelligence, or AI is the field that studies the

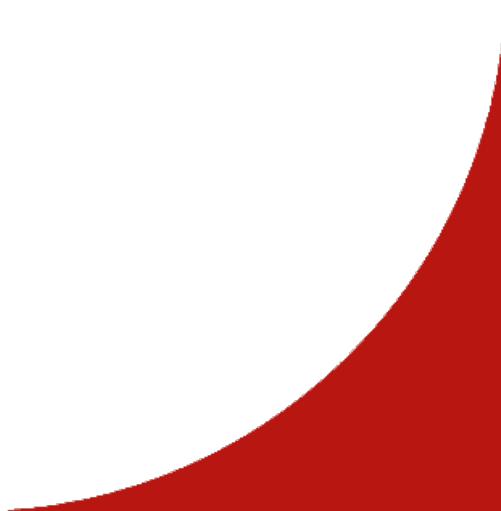
synthesis and analysis of computational agents that act rationally

Definition of AI

69

Artificial Intelligence: A Modern Approach, 2016, Russell & Norvig

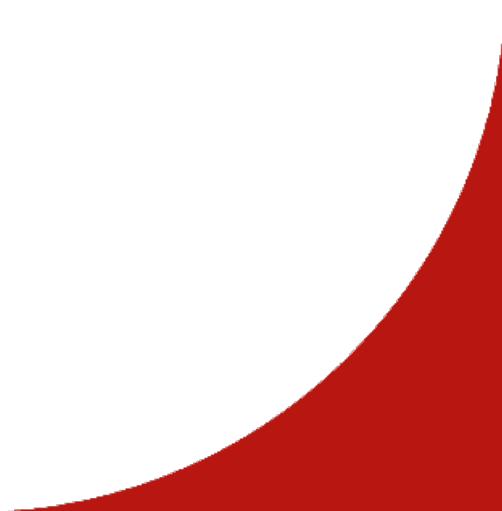
Artificial Intelligence: Foundations of Computational Agents, 2017, Poole & Markworth



(Q) Describe: Questions?

69 Questions?

70





(Q) Describe: Two types of goals: Scientific and Engineering

70 Two types of goals: Scientific and Engineering

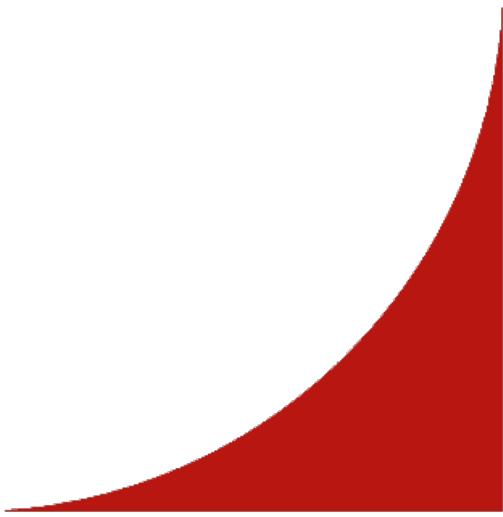
- Scientific goal – understand the principles of intelligent behaviour:
- Analysis of natural and artificial agents
- Formulating and testing hypothesis
- Designing, building and experimenting with computational agents
- Uses a general scientific approach
- Focuses on building empirical systems
- And not on the final applications that could be deployed to use

Goals of AI

71

Artificial Intelligence: Foundations of Computational Agents, 2017, Poole & Markworth





(Q) Describe: Two types of goals: Scientific and Engineering

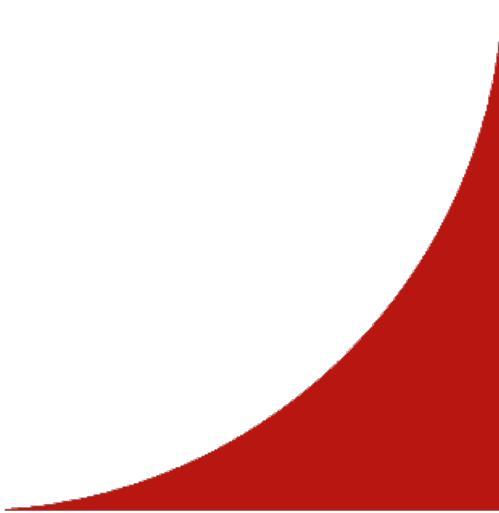
71 Two types of goals: Scientific and Engineering

- Engineering goal – concerned with constructing intelligent agents
- Focuses on the design and synthesis of useful, intelligent artefacts.
- Builds agents that act intelligently
- Agents that are useful in many real-world applications

Goals of AI

72

Artificial Intelligence: Foundations of Computational Agents, 2017, Poole & Markworth



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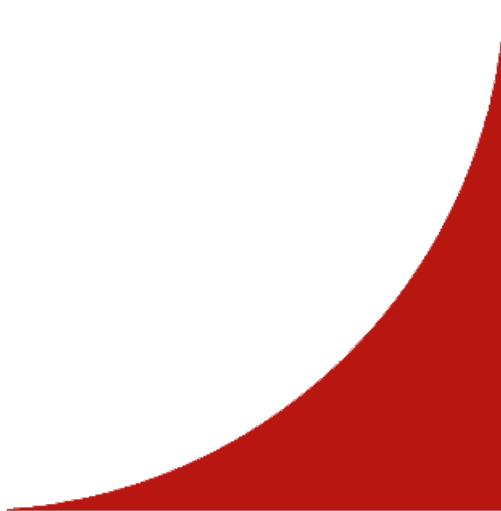
(Q) Describe: Workflow/Process automation

72 Workflow/Process automation

- Use of bots for routine, repetitive tasks
- Enhance creative tasks
- More time and tools to explore creative functions
- Increased accuracy
- Human errors can be reduced
- Better predictions & improved decision making
- Predictions of risks, performance targets, tailored product offerings etc

Business Benefits of AI

73



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(Q) Describe: Healthcare

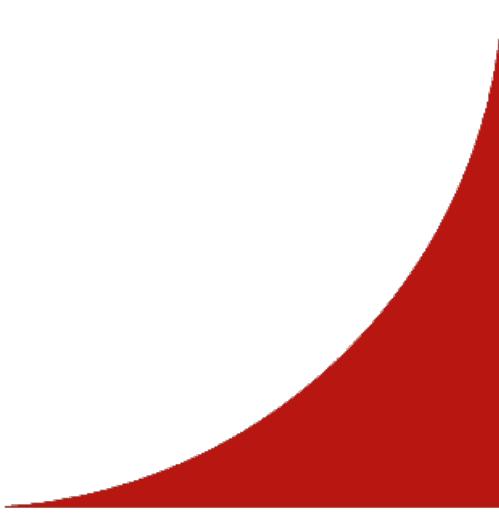
73 Healthcare

- There is a huge effort in mobilizing AI for health.
- Smart cities, transportation, security
- Maps, navigation systems, unmanned vehicles, route planning, security
- Forecasts and predictions
- Weather, natural disasters, earthquakes, hurricanes, stock prices, economic
- Agriculture
- Real-time data analytics help farmers to maximise their crop yields and profits
- Overall lifestyle

Social benefits of AI

74





•

(Q) Describe: Safety and security

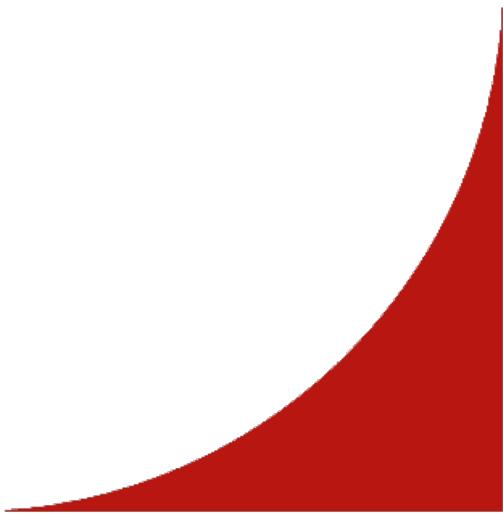
74 Safety and security

- Driverless cars can be hacked
- Failed Facebook AI chatbot experiment
- Racist hijack of Microsoft AI Tweeter feed
- Trust and social manipulation
- Facebook-Cambridge Analytica Scandal
- Explainable (or Interpretable) AI (XAI)
- Deep neural models are naturally opaque
- Possible job losses
- “AI will replace more than 75 million jobs by 2022” – World Economic Forum

Risks and Challenges of AI

75





•

(Q) Describe: Accountability

75 Accountability

- If AI violates ethical rules, who will be responsible?
- Accuracy, bias, privacy and inequality
- AI learns from data provided by humans which may encode human biases and

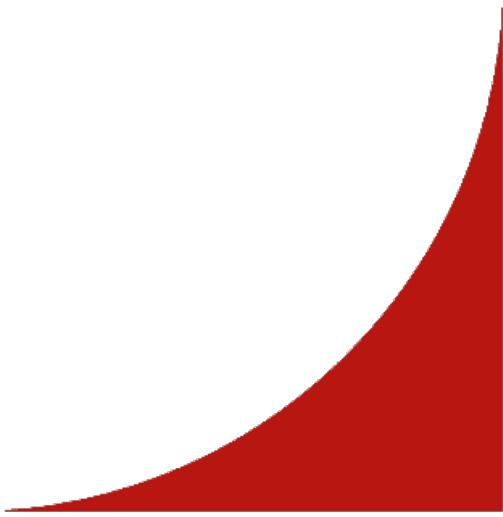
prejudices

- Facial recognition to ‘predict criminals’ sparks row over AI bias – BBC
- IBM abandons “biased” facial recognition tech – BBC
- Technological social responsibility (TSR)
- a conscious alignment between short- and medium-term business goals and

longer-term societal ones – McKinsey Quarterly, August, 2019
Ethical Concerns of AI

76





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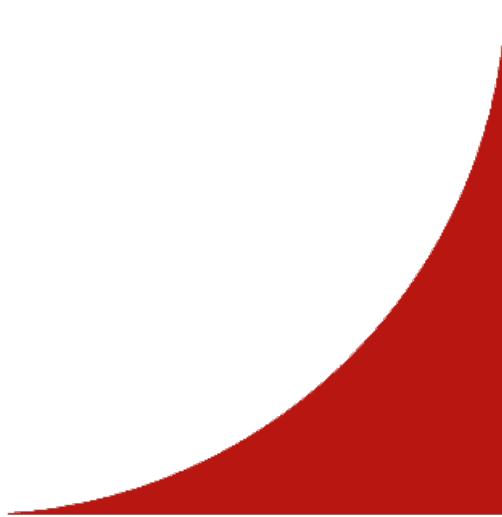
(Q) Describe: Artificial Intelligence: An overview

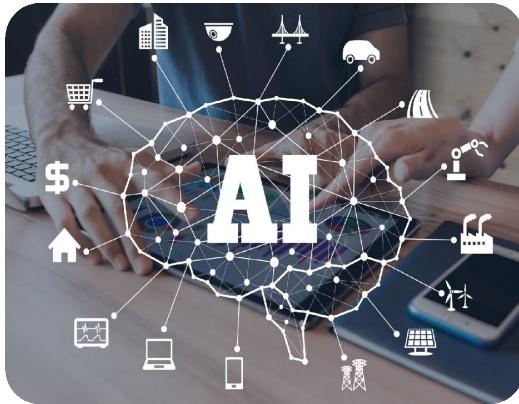
76 Artificial Intelligence: An overview

- Application, history, foundations of AI
- Definition of AI
- Goals of AI
- AI and the Society
- Benefits
- Risk and Challenges
- Ethical Issues

AI Summary

77

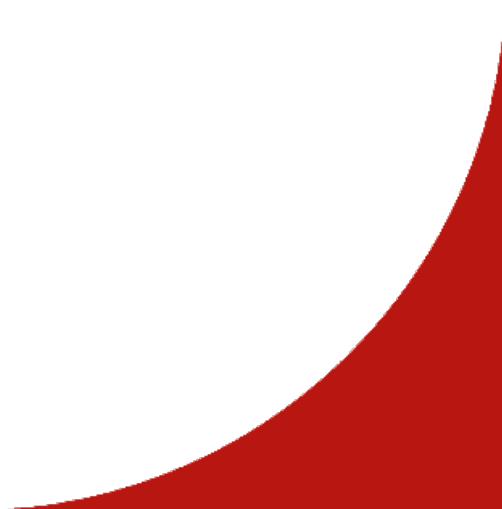




(Q) Describe: Questions?

77 Questions?

78



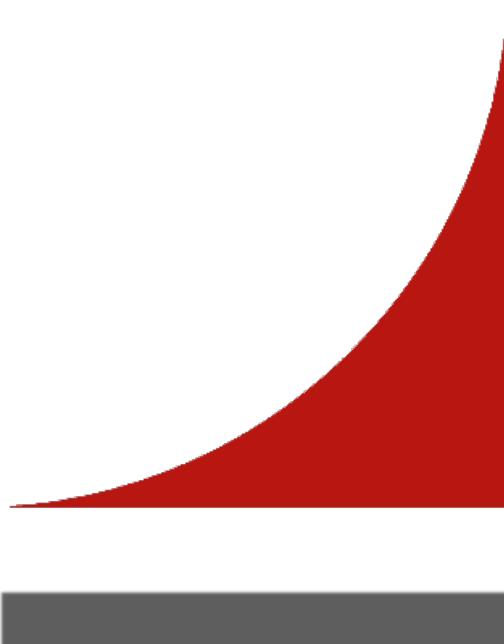


(Q) Describe: SCC361: Artificial Intelligence

78 SCC361: Artificial Intelligence

79

Lectures, Materials and Expectations
Introduction to the Module
Overview of Artificial Intelligence
Overview of Machine Learning



Lectures, Materials and Expectations



Introduction to the Module

Overview of Artificial Intelligence

Overview of Machine Learning



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(Q) Describe: Overview of Machine Learning

79 Overview of Machine Learning

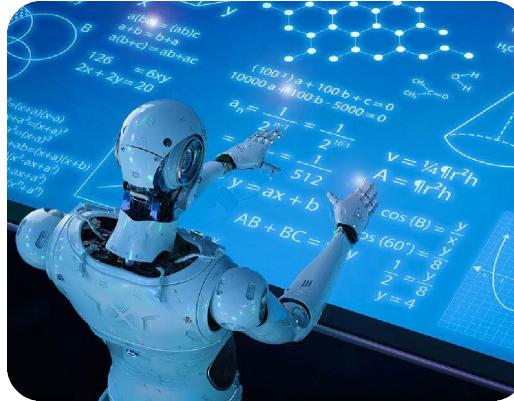
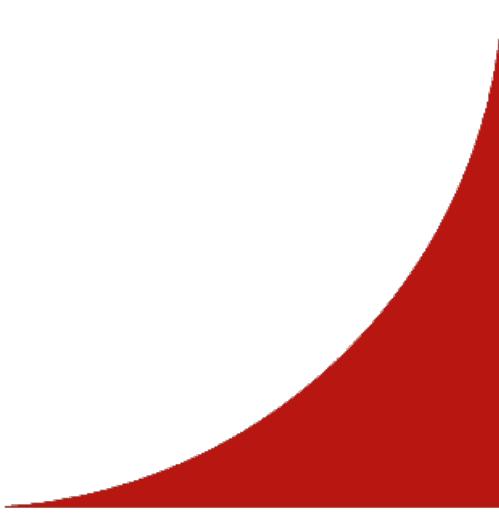
- AI and ML, Definitions of ML, How to learn

- Types of Machine Learning
 - Supervised, unsupervised, semi supervised

- Supervised Learning
 - Classification and regression
 - Unsupervised Learning
 - Clustering and association

Introduction to Machine Learning
80





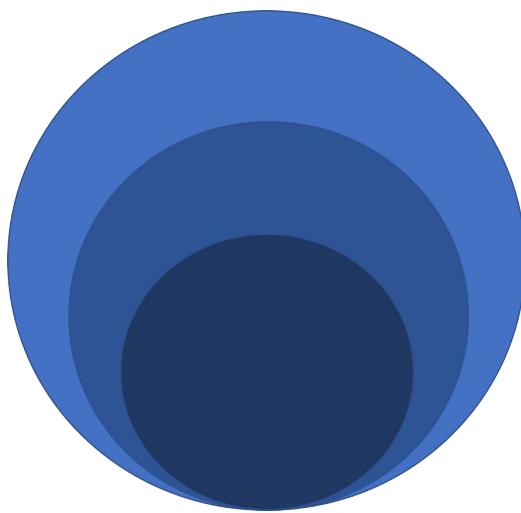
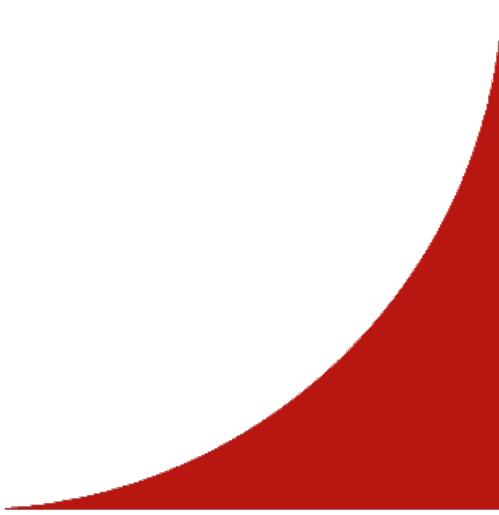
•

(Q) Describe: AI systems were mostly rule-based

80 AI systems were mostly rule-based

- i.e. depended on hand-crafted rules
 - Machine learning drives AI
 - Learning algorithms create a logical mapping from data to output
-
- Deep learning:
 - a subset of ML with additional layers to learn deeper representations data
- AI and Machine Learning
81
Artificial Intelligence
Machine Learning
Deep Learning





Artificial Intelligence

Machine Learning

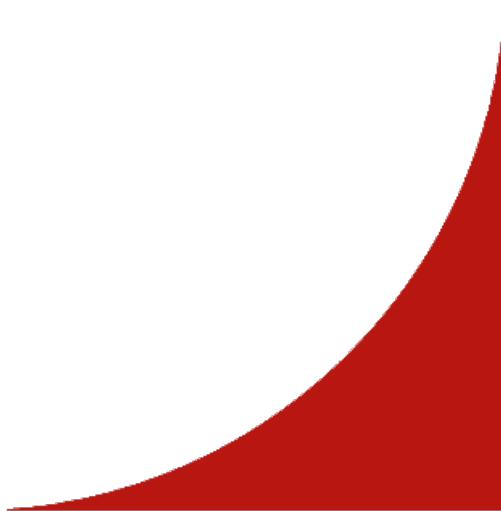
Deep Learning

(Q) Describe: Early definition of machine learning

81 Early definition of machine learning

“Field of study that gives computers the ability to learn without being explicitly programmed”

- Arthur Samuel (1959)
 - ML pioneer that built first “self-learning” program that played checkers by learning from experience
 - Inverted alpha-beta pruning widely used in decision tree searching
- What is Machine Learning?
82





(Q) Describe: Another popular definition:

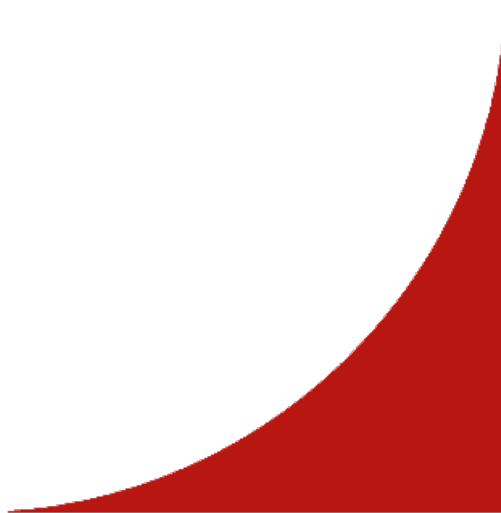
82 Another popular definition:

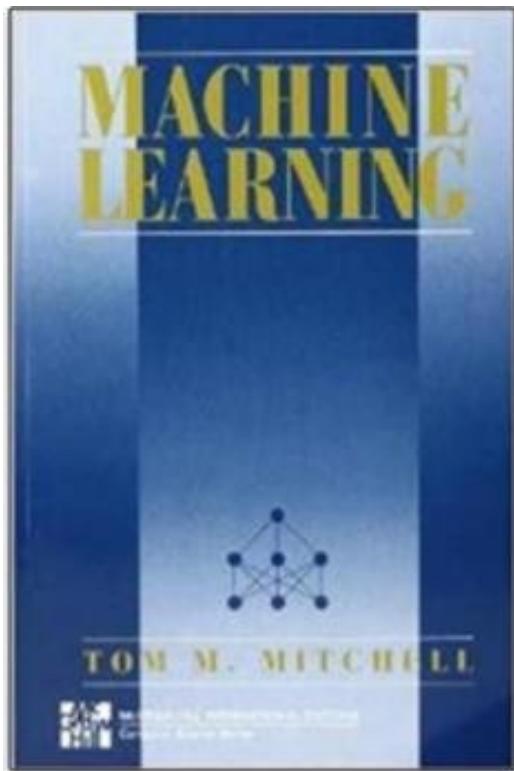
“A computer is said to learn from experience E with respect to task T and some performance measure P, if its performance on T, as measured by P, improved with experience E”

- Tom Mitchell (1997)
 - Again, the key is learning from experience
 - Not explicitly programmed

What is Machine Learning?

83

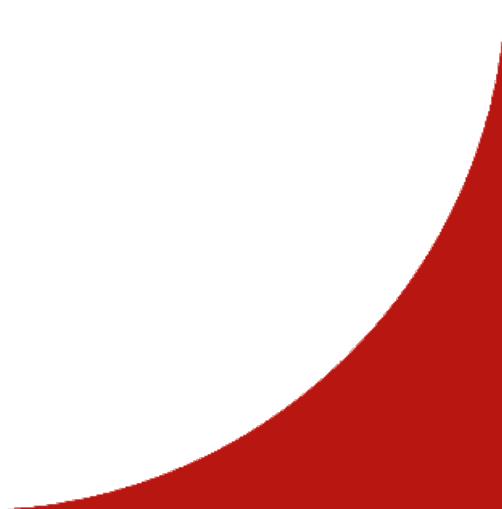


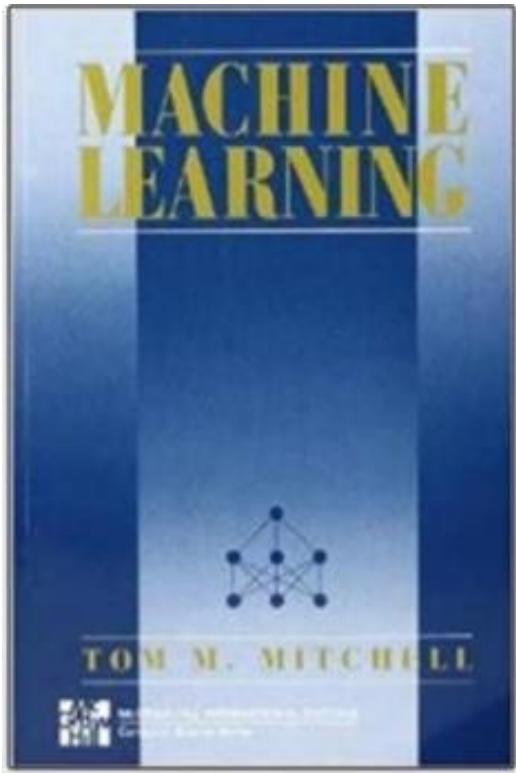


(Q) Describe: What is Machine Learning?

83 What is Machine Learning?

84





The image is a composite of two parts. On the left is a portrait photograph of Tom M. Mitchell, a middle-aged man with grey hair, wearing a light blue button-down shirt, gesturing with his hands while speaking. On the right is a dark rectangular box containing a quote and some text. The quote is: “Machine learning is the study of computer algorithms that allow computer programs to automatically improve through experience.” This is attributed to “~ Tom Mitchell, Machine Learning, McGraw Hill, 1997” and “Carnegie Mellon University Machine Learning”.

“Machine learning is the study of computer algorithms that allow computer programs to automatically improve through experience.”

~ Tom Mitchell,
Machine Learning, McGraw Hill, 1997
Carnegie Mellon University
Machine Learning

(Q) Describe: Given this definition:

84 Given this definition:

“A computer is said to learn from experience E with respect to task T and some performance measure P, if its performance on T, as measured by P, improved with experience E”

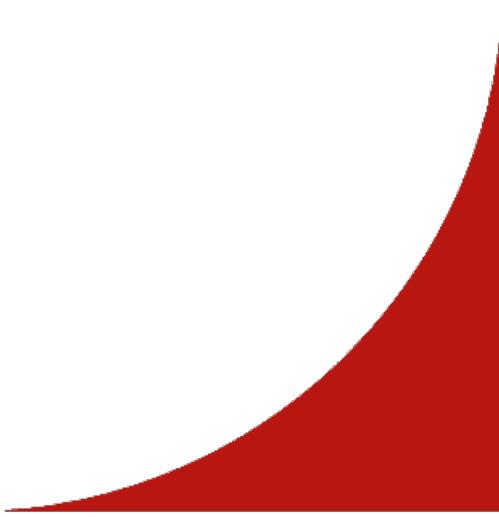
My email program watches me mark some emails as spam, and improves on filtering spams. What is the T, E and P in the setting?

- a. Watching me label emails as spam
- b. Classifying emails as spam or not spam
- c. The fraction of emails correctly classified as spam or not
- d. None of the above – this is not a machine learning problem

Spam or not SPAM

85





•

(Q) Describe: Consider the function $=()$ (e.g. $=$)

85 Consider the function $=()$ (e.g. $=$)

- Traditional Programming (Software 1.0)
- Machine Learning (Software 2.0)

What is Machine Learning?

86

Computer

Data ()

Program (=)

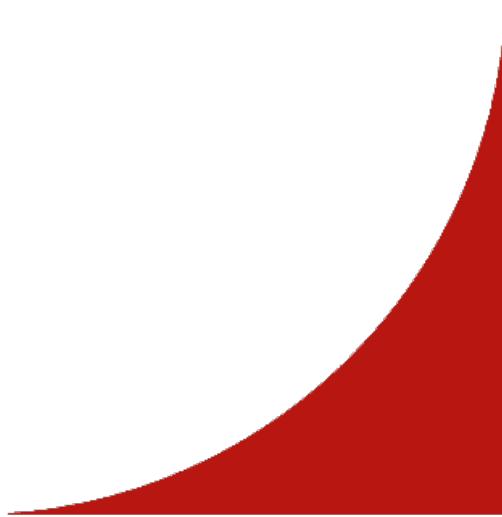
Output ()

Computer

Data ()

Output ()

Program (=)



•

(Q) Describe: Consider the function $=()$ (e.g. $=$)

86 Consider the function $=()$ (e.g. $=$)

- Traditional Programming (Software 1.0)
- Machine Learning (Software 2.0)

What is Machine Learning?

87

Computer

Data ()

Program (=)

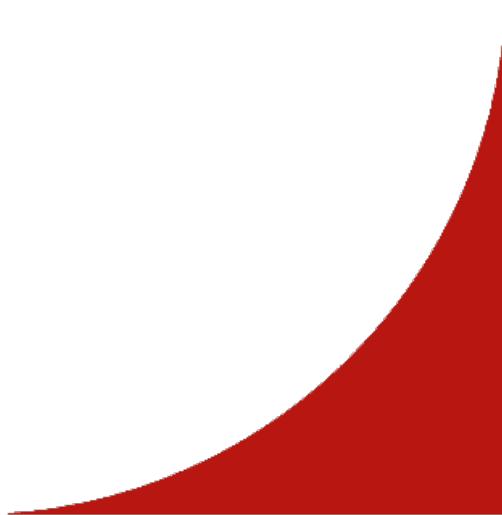
Output ()

Computer

Data ()

Output ()

Program (=)



•

(Q) Describe: Memorization

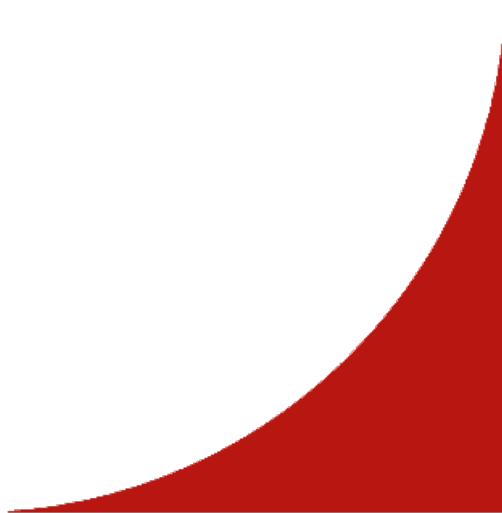
87 Memorization

- Accumulation of individual facts
- Limited by
 - Time to observe facts
 - Memory to store facts

How things are learned

88

Declarative knowledge



(Q) Describe: Memorization

88 Memorization

- Accumulation of individual facts
- Limited by
 - Time to observe facts
 - Memory to store facts
 - Generalization
 - Deduce new facts from old facts
 - Limited by accuracy of deduction process
 - Essentially a predictive activity
 - Assumes that the past predicts the future

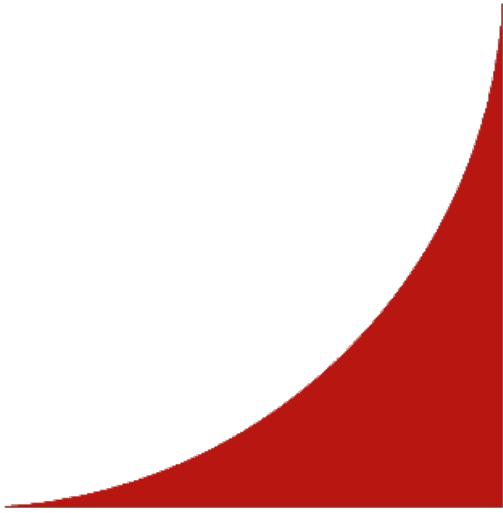
How things are learned

89

Imperative knowledge

Declarative knowledge





(Q) Describe: Supervised Learning

89 Supervised Learning

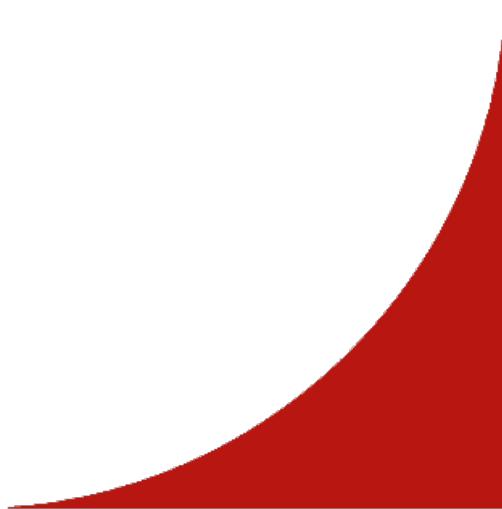
- Classification
- Regression

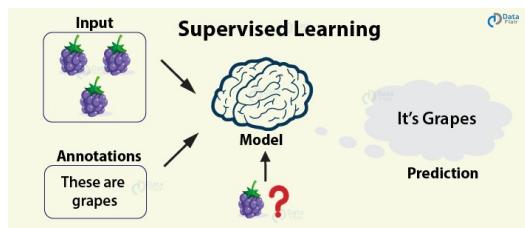
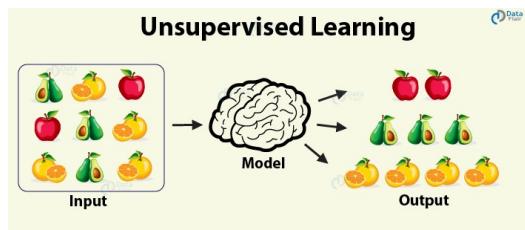
Unsupervised Learning

- Clustering
- Association

Types of Machine Learning

90





(Q) Describe: The algorithm learns to map an input to a

90 The algorithm learns to map an input to a

particular output.

- Instances of data are presented along with their correctly labelled output

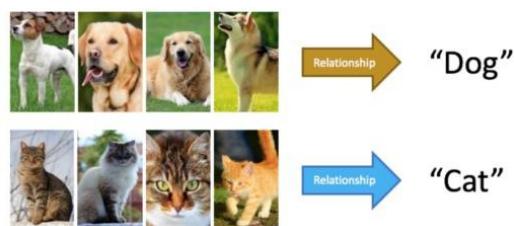
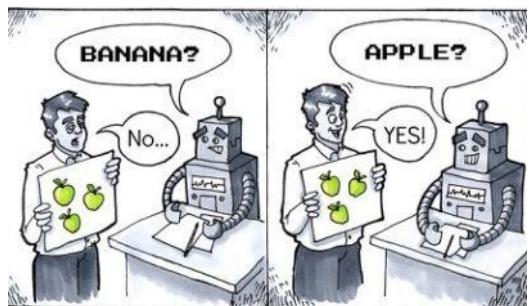
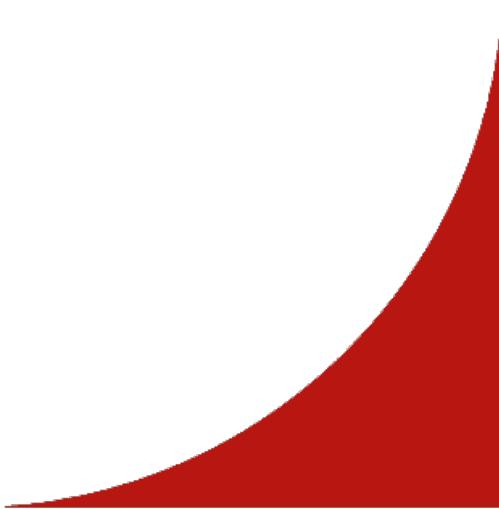
- Similar to a teacher-student scenario
- The algorithm learns from experience to predict

new unseen data

- Two broad categories:
 - Regression
 - Classification

Supervised Learning
91





(Q) Describe: Supervised Learning

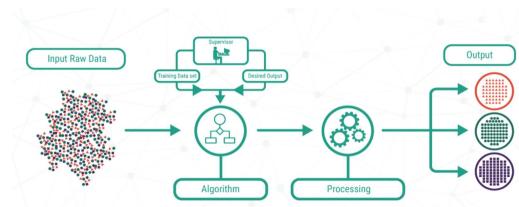
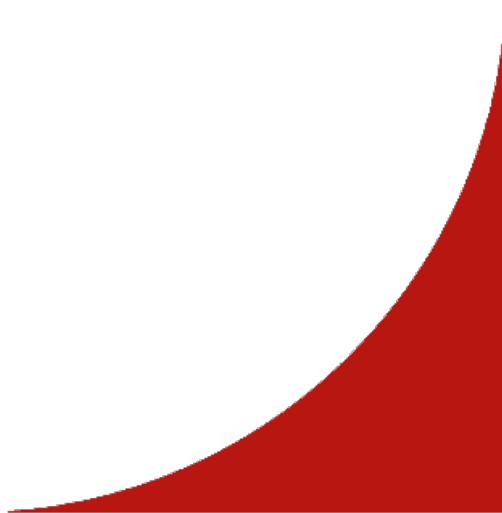
91 Supervised Learning

92

Input labelled data Training process

New unseen data Algorithms

Trained Model Output



(Q) Describe: Learns from labelled data (supervised)

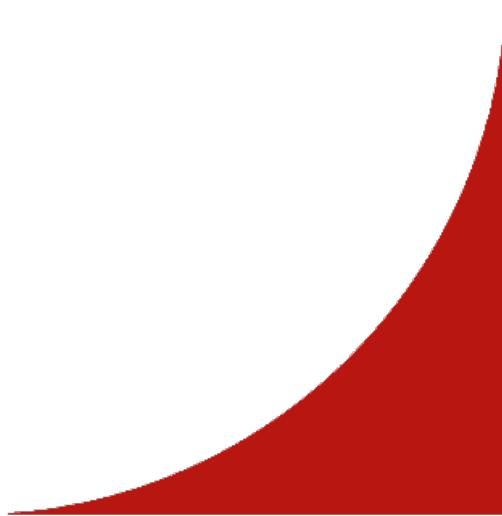
92 Learns from labelled data (supervised)

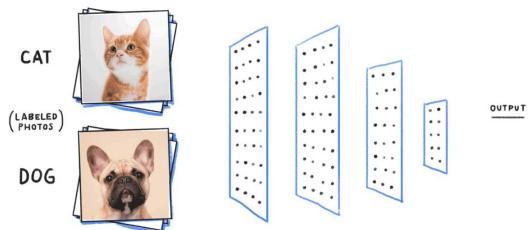
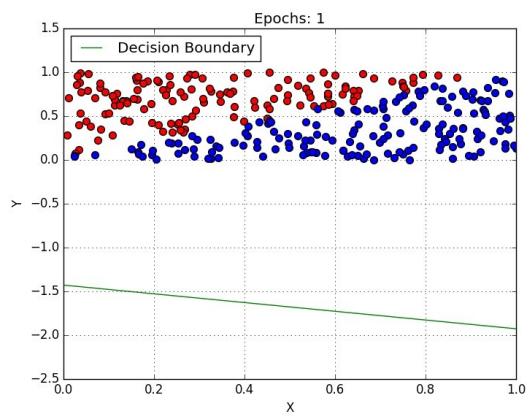
- Predicts a category or a class
- Cats|Dogs
- Spam|Ham
- Cancer|Not Cancer
- Attempts to separate the data into specific

categories (or classes or labels)

Classification

93



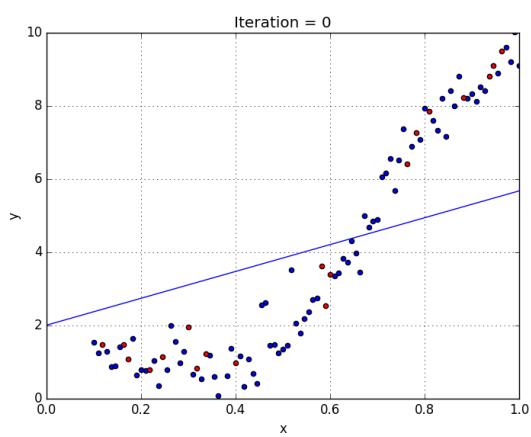
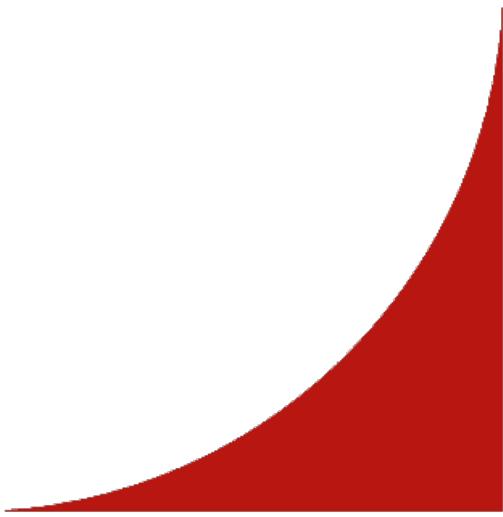


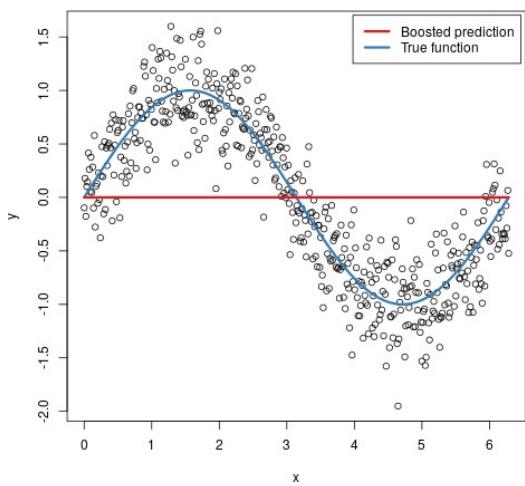
(Q) Describe: Learns from labelled data (supervised)

93 Learns from labelled data (supervised)

- Predicts a continuous-valued output
 - height, price, duration etc.
 - Consider a function =
 - we want our model to predict given
 - not seen during training
 - Typically fits some linear or quadratic curve of the data plot
-
- Linear or logistic regression algorithms are often used
- Regression
94







(Q) Describe: Input data = training data

94 Input data = training data

- with labels e.g. spam/ham or stock price at
- In training
- the model makes a prediction and is corrected

if the prediction is wrong

- Training process continues until a desired

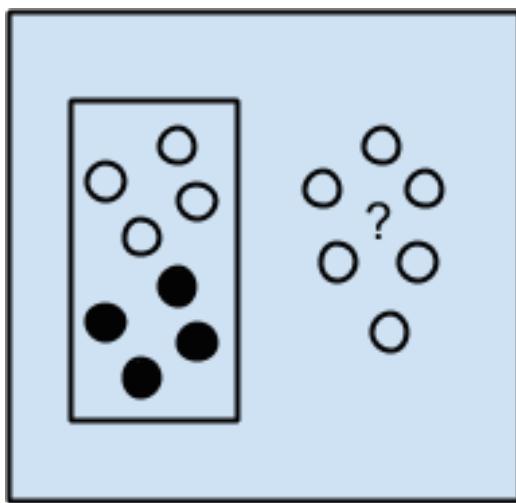
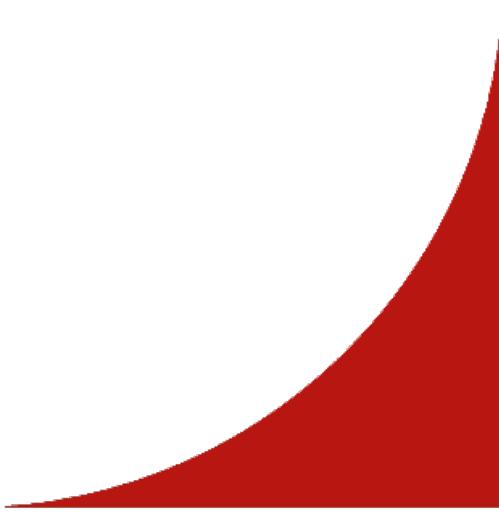
accuracy is achieved

- Problem types: Classification and Regression
- Algorithms:
- Logistic Regression
- Back Propagation Neural Network.

Supervised Learning Algorithms

95





Supervised Learning
Algorithms

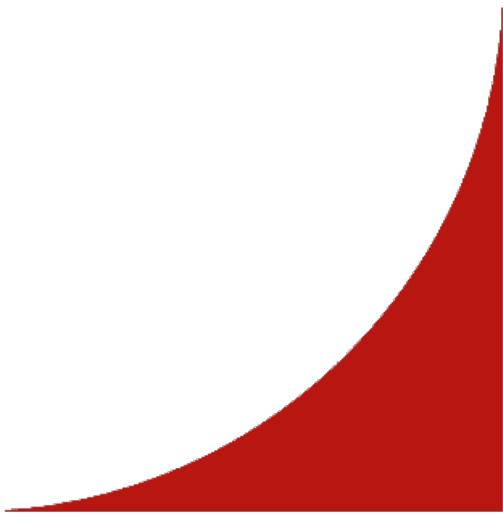
•

(Q) Describe: If we wish to learn models to address the following

95 If we wish to learn models to address the following

1. Predict how many students will enrol in this module in the next 3 years given the past enrolment data
 2. Predict whether a student will pass the module given previous years records
 - How should we proceed
 - a. Both are regression problems
 - b. Both are classification problems
 - c. Problem 1 is regression while Problem 2 is classification
 - d. Problem 2 is regression while Problem 1 is classification
- Quiz: Classification vs Regression
- 96





•

(Q) Describe: Remember the function =

96 Remember the function ==

- With unsupervised learning, only the input data, , is available

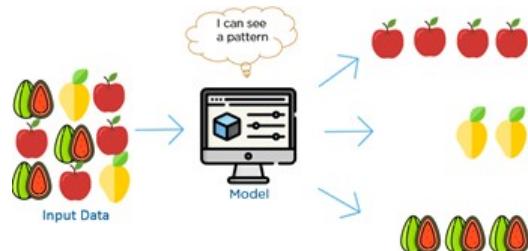
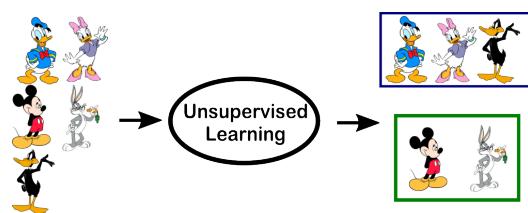
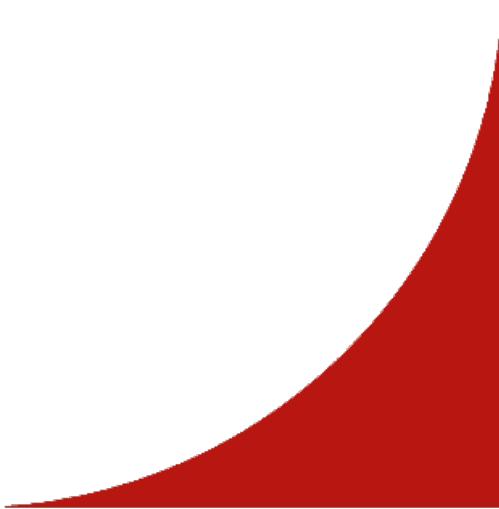
- There are no corresponding labels (classes or categories) i.e. no output variable,

- Aims at modelling the underlying structure of the data

- Two main categories
- Clustering
- Association

Unsupervised Learning
97

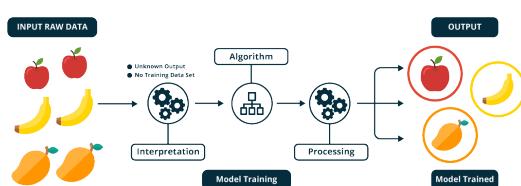
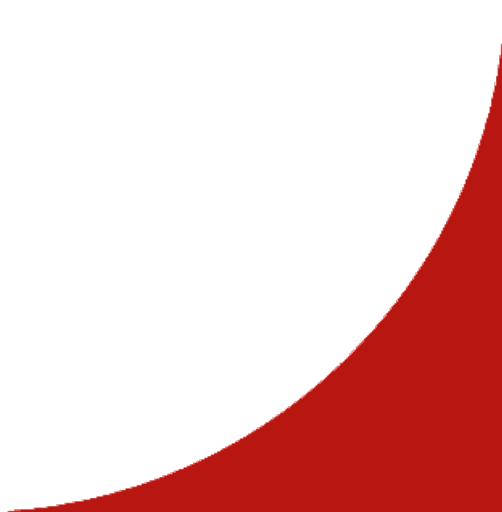




(Q) Describe: Unsupervised Learning

97 Unsupervised Learning

98
No labels



Model Trained

•

(Q) Describe: In a clustering problem, we want to discover

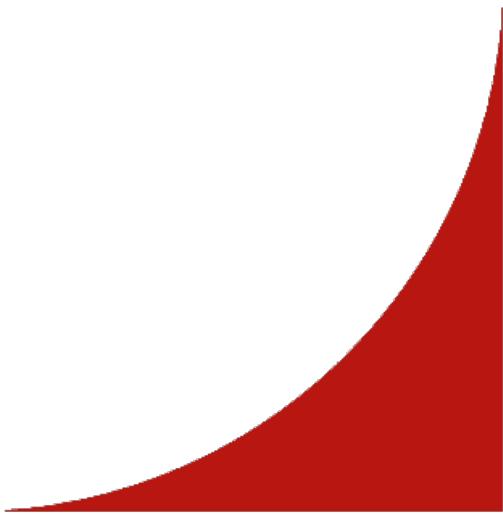
98 In a clustering problem, we want to discover

the inherent groupings in the data:

- Eg: grouping customers by purchasing behaviour.
- In an association rule learning problem, we want to discover rules that describe large portions of your data
 - E.g. people that buy A also tend to buy B

Clustering and Association
99





•

(Q) Describe: Input data is not labelled

99 Input data in not labelled

- Output not known
- In training
- Deduces structures present in the input data
- Extracting general rules, reducing redundancy or

organise data by similarity

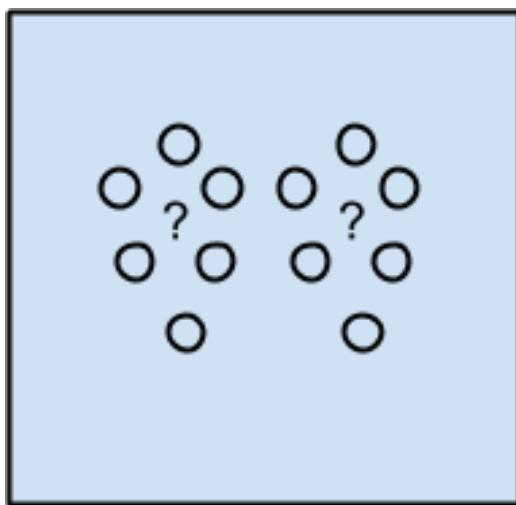
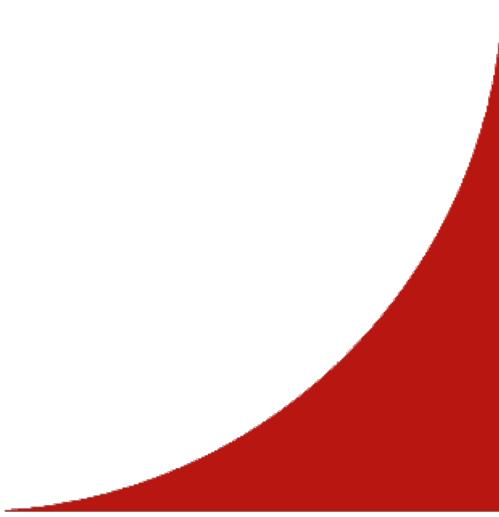
- Problem types: clustering, dimensionality reduction

and association rule learning

- Algorithms:
- K-Means algorithm
- Apriori algorithm.

Unsupervised Learning Algorithms
10
0





Unsupervised Learning Algorithms

•

(Q) Describe: Semi-supervised learning approach refers to:

100 Semi-supervised learning approach refers to:

- when we have a large amount of input data () but only some of the data is labelled ()
 - e.g. a photo archive where only some of the images are labelled, (e.g. dog, cat, person) and the majority are unlabelled.
- Many real world problems adopt this method
- It can be expensive or time-consuming to label data
- A hybrid design often helps to bridge the gaps
- Algorithms:
 - A flexible combination of supervised and unsupervised

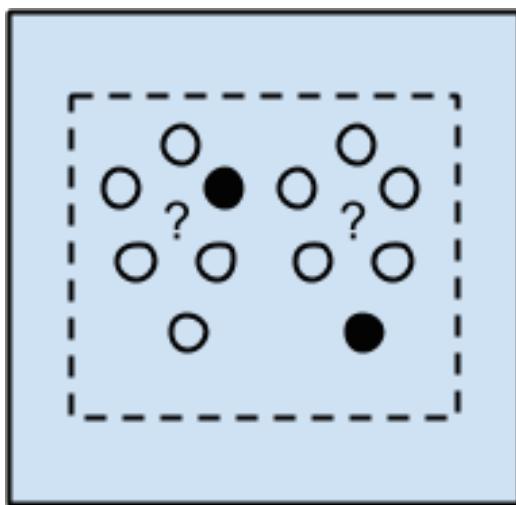
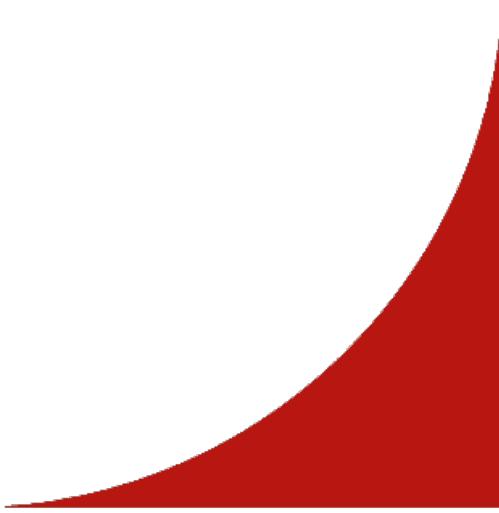
algorithms

Semi-supervised Learning

10

1





Semi-supervised
Learning Algorithms

(Q) Describe: Today's Lecture

101 Today's Lecture

- Overview of Machine Learning
- AI and ML, Definitions of ML, How to learn

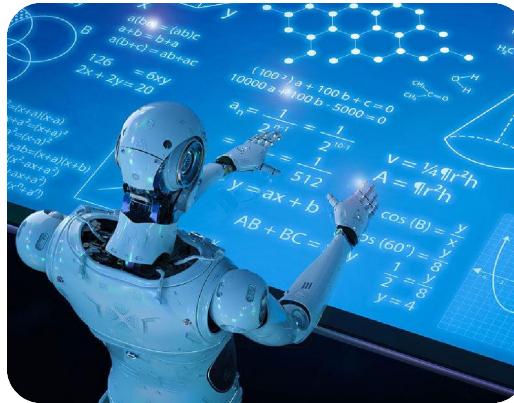
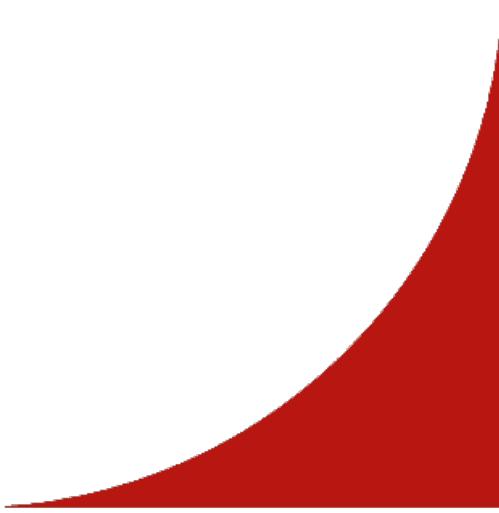
- Types of Machine Learning
 - Supervised, unsupervised, semi-supervised
- Supervised Learning
 - Classification and regression
 - Unsupervised Learning
 - Clustering and association

Machine Learning Summary

10

2





(Q) Describe: Labs: Introduction to Matlab

102 Labs: Introduction to Matlab

- Materials on Moodle / Teams Files

Coming up...

10

3

Group Day Time Room

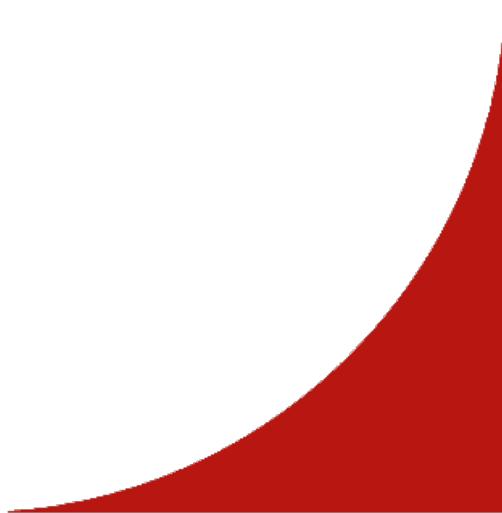
SCC361/P01/01 Wednesday 11:00-13:00 FST B076

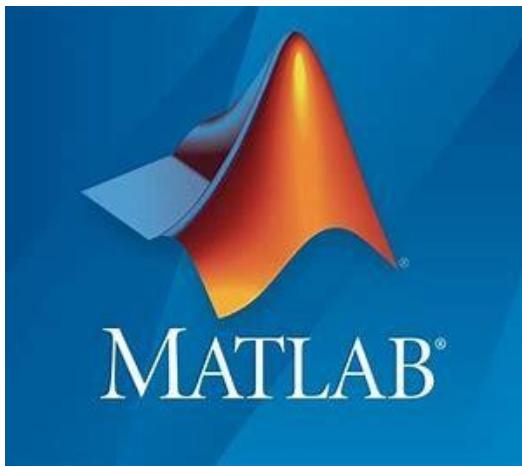
SCC361/P01/02 Thursday 16:00-18:00 FST B076

SCC361/P01/03 Friday 16:00-18:00 FST B070

SCC361/P01/04 Thursday 10:00-12:00 FST B070

SCC361/P01/05 Friday 11:00-13:00 FST B080





(Q) Describe: Labs: Introduction to Matlab

103 Labs: Introduction to Matlab

- Materials on Moodle / Teams Files

Week 2 Lectures: Features in Machine Learning and Feature Extraction

- What are features?
- How to extract/represent features from text, images

Coming up...

10

4

Group Day Time Room

SCC361/P01/01 Wednesday 11:00-13:00 FST B076

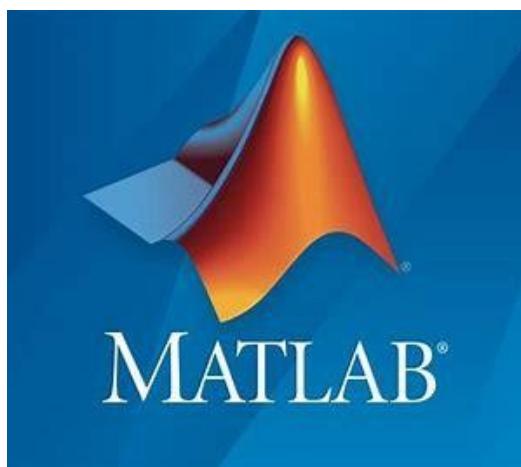
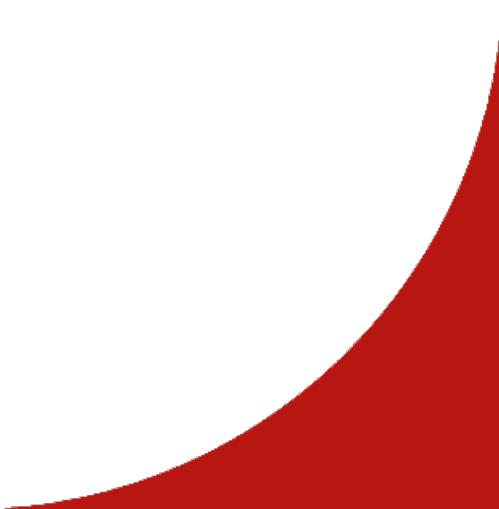
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SCC361/P01/05 Friday 11:00-13:00 FST B080



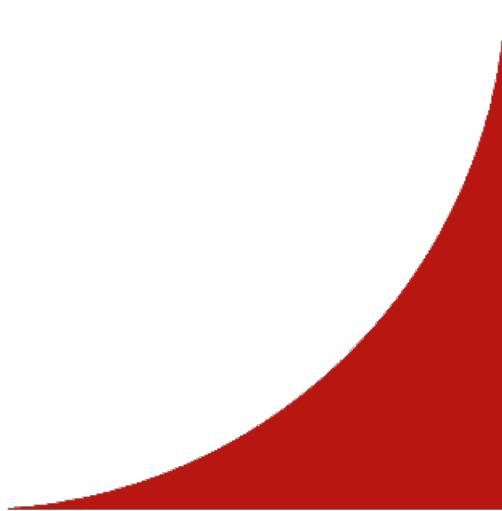




(Q) Describe: Questions?

104 Questions?

10
5





(Q) Describe: ...

(Q) Describe: ...