MAI 5100: Fundamentals of Artificial Intelligence

Instructor: Dr. Christopher Clarke

Overview & Agenda

1. **What is AI?**
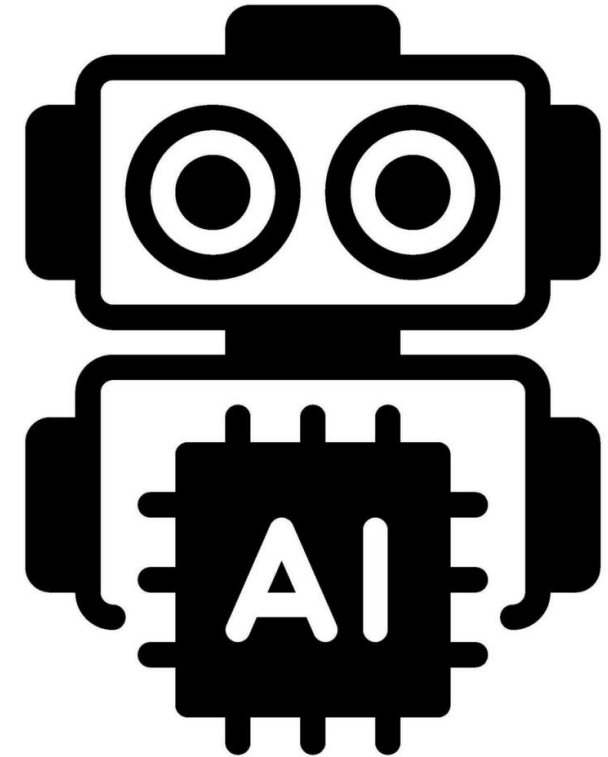
   - Definitions

   - AI vs. Human Intelligence

2. **Historical Developments**

   - Early days, AI winter, modern revival

   - Key milestones & breakthroughs

3. **Fundamental Issues & Challenges**

   - Data, computational limitations, ethics, bias

Overview & Agenda (Contd.)

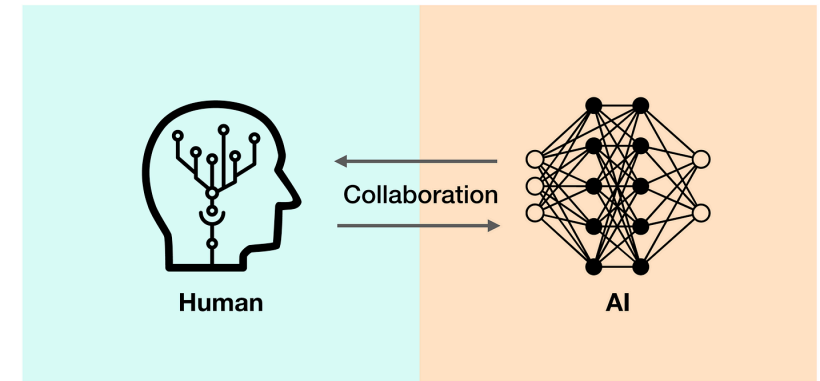4. **Course Objectives & Content**

   ○ Topics from search to deep learning

   ○ Weekly schedule & major assignments

5. **Implications for Developing Nations**

   ○ Resource constraints, local solutions

6. **Careers & Pathways in AI**

   ○ Local & global opportunities

   ○ Research vs. industry

Collaboration

Human

AI

Introductions

Instructor:

- **Name:** Dr. Christopher Clarke

- **Email:** christopher.clarke@uog.edu.gy

- **Profile:** csclarke.com

- **Research Interests:** Natural Language Processing, Human-AI Interaction
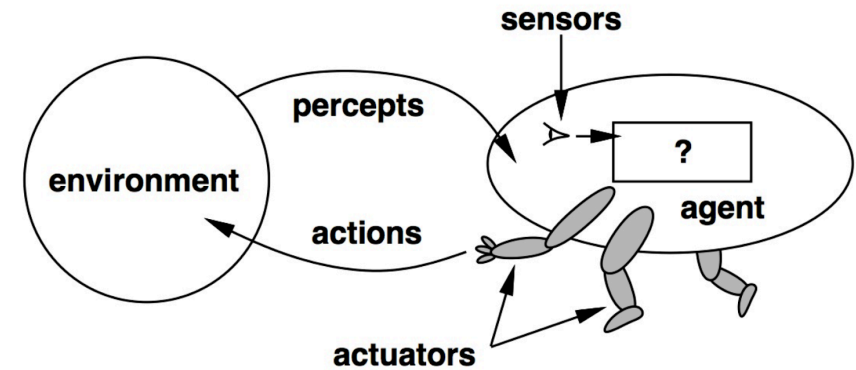
Your Turn

- Share your name, background, and why you're interested in AI.

- **Icebreaker:** What's your favorite AI application or technology?

What is AI?

The science of making machines that:

- Think like humans?

- Act like humans?

- Think rationally?

- Act rationally?

> "A computer would deserve to be called intelligent if it could deceive a human into believing that it was human." – **Alan Turing**

In **this course**, we adopt a **rational agent** viewpoint:

- An **agent** perceives its environment, reasons about it, and acts to **maximize** its goals.

- AI is about designing such **intelligent agents**.

Brief History of AI

1940s - 1960s: The Beginnings

- McCulloch & Pitts: Boolean circuits as "neurons"

- Turing's famous paper on "Computing Machinery and Intelligence"

- Emergence of symbolic AI, problem solving, and rule-based systems

1970s - 1980s: Knowledge & Expert Systems

- Surge of expert systems (e.g., MYCIN for medical diagnosis)

- First "AI Winter" after hype fails to meet expectations

1990s - 2000s: Statistical & Probabilistic Turn

- Probabilistic reasoning (Bayes Nets, Markov Models)

- IBM's Deep Blue defeats Kasparov in Chess (1997)

Brief History of AI (Contd.)

2000s - 2010: Rise of Machine Learning

- Support Vector Machines, Random Forests, and other ML algorithms

- Google's self-driving car project (2009), now Waymo

- IBM's Watson wins Jeopardy! (2011)

2010 - Present: Deep Learning & Big Data

- Neural networks, GPUs, & breakthroughs in speech, vision

- AlphaGo beats Lee Sedol in Go (2016)

- Large Language Models (LLMs) & generative AI

We've come a long way, from punch cards to [ChatGPT]!

The AI Landscape

Artificial Intelligence

Machine Learning

Deep Learning

Generative AI
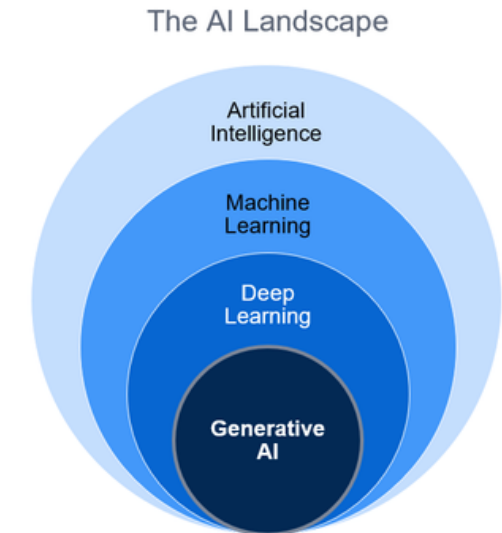
AI Applications

- **Healthcare**: Diagnostics, personalized medicine, and telemedicine.

- **Agriculture**: Crop monitoring, pest detection, predictive analytics for better yields.

- **Finance**: Credit scoring, fraud detection, automated customer service.

- **Education**: Intelligent tutoring systems, adaptive learning platforms.

- **Natural Language Processing**: Translation, virtual assistants, sentiment analysis.

- **Transportation**: Self-driving cars, logistics optimization.

"AI won't replace farmers, but farmers using AI will replace those who don't." 🚜🤖

AI in a Developing Nation Context 🇬🇾

> *"Sometimes constraints are the mother of innovation!"*

- **Resource Constraints**

  - Limited high-performance computing infrastructure.

  - Opportunities for lightweight models, low-power solutions, and creative problem-solving.

- **Localized Solutions**

  - Focusing on **agriculture**, **healthcare**, and **education** to create immediate community impact.

  - Developing chatbots that converse in local dialects.

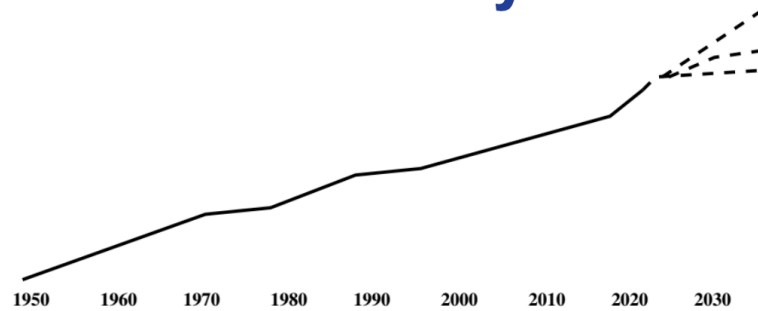# AI in a Developing Nation Context 🇬🇾 (Contd.)

- **Skill Gaps & Education**

  - Necessity for building foundational digital literacy.

  - Community-driven projects, open-source collaborations.

- **Ethical & Cultural Implications**

  - Ensuring AI respects local traditions and languages.

  - Mitigating bias and misinformation, bridging the digital divide.
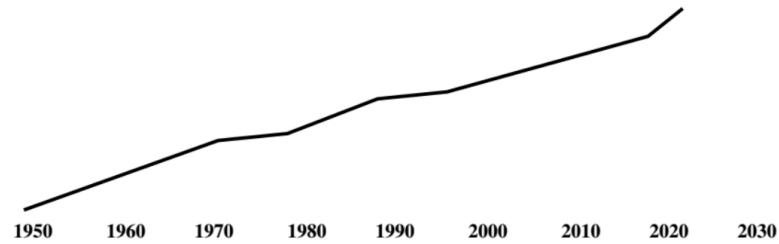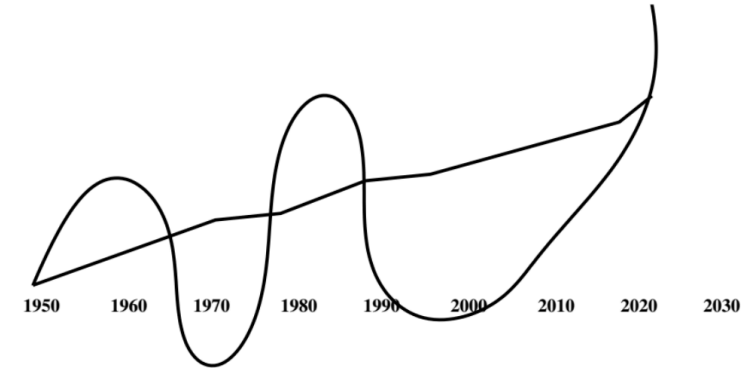
AI Hype vs. Reality
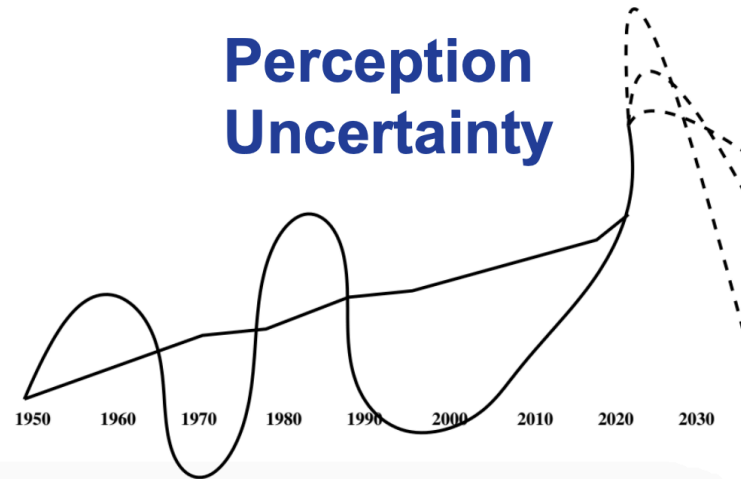
Fundamental AI Issues

1. **Data & Representation**

   ○ "Garbage in, garbage out"

   ○ Need for high-quality, representative data

2. **Computational Resources**

   ○ AI can be **computationally expensive**

   ○ Efficient algorithms & specialized hardware are key

3. **Uncertainty & Probabilistic Reasoning**

   ○ Real-world data is messy, incomplete, noisy

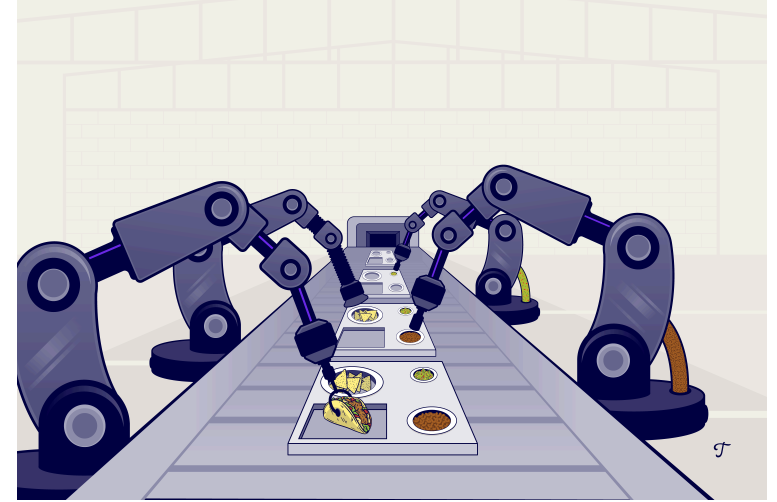# Fundamental AI Issues (Contd.)

4. **Ethics & Bias**

- AI systems can reflect and amplify societal biases
- Ethical frameworks, fairness, explainability

5. **Planning & Decision-Making**

- Many real-world tasks require multi-step reasoning
- Search algorithms, constraint satisfaction

6. **Societal Impact**

- Automation fears, labor shifts
- Regulatory & governance questions

Why Study AI?

1. **We are in the 4th Industrial Revolution**

   - AI is transforming industries, economies, and societies.

   - Mechanization -> Electrification -> Computerization -> AI

2. **Field is rapidly evolving, but still in its infancy**

   - New algorithms, models, and applications emerge daily.

   - Opportunities for innovation, research, and entrepreneurship.

3. **Interdisciplinary Nature**

   - AI draws from computer science, statistics, psychology, philosophy.

   - AI touches every domain: healthcare, finance, agriculture, education etc.

Why Study AI? (Contd.)

4. **Massive Demand for AI Talent**

- Shortage of AI professionals worldwide.

- High salaries, job security, and opportunities for growth.

5. **Guyana 🇬🇾 needs your expertise!!!**

- Oil & gas won't last forever. AI can drive sustainable development.

- Opportuninity to accelerate local innovation, solve unique problems.

Course Objectives

By the end of **MAI5100** you should be able to:

1. **Explain** foundational AI concepts

2. **Apply** search algorithms, knowledge representation, and machine learning approaches

3. **Design** intelligent agents capable of problem solving under uncertainty

4. **Evaluate** AI solutions with appropriate metrics and ethical considerations

5. **Develop** small-scale AI projects (research or applied focus)

Disclaimer: This course is a **starting point** and does not cover modern AI in its entirety! However, many of the principles covered are the foundation of most of the state-of-the-art AI systems you see today.

Weekly Roadmap (Weeks 1 - 4)

Week	Topics	Readings / Activities
1	*Intro to AI* - Historical context, challenges	Chapter 1; HW0 released
2	*Search Techniques* - BFS, DFS, A*, heuristics	Chapter 3; Group project formation
3	*Advanced Search & CSPs* - Adversarial search	Chapters 5 & 6
4	*Knowledge & Reasoning* - Logic, Bayes Theorem	Chapters 7 & 8; HW1 released

Weekly Roadmap (Weeks 5 - 8)

Week	Topics	Readings / Activities
5 - 6	*Probabilistic Reasoning* - Bayesian Networks, MDPs, RL	Chapters 13 - 14; Guest lecture by Dr. Roland Daynuath
7	*Planning in AI* - Classical planning, scheduling	Chapter 11
8	*Mid-term Exam*	No new readings

Weekly Roadmap (Weeks 9 - 12)

Week	Topics	Readings / Activities
9	*Machine Learning (Part 1)* - Supervised & Unsupervised	Chapters 19 – 20; HW2
10	**No Class (May 3)**	-
11	*Machine Learning (Part 2)* - Neural Networks & Optimization	Chapter 21; Project progress
12	*Deep Learning Advanced* - CNNs, RNNs, Transformers	Chapter 21.6 - 21.8

Weekly Roadmap (Weeks 13 - 15)

Week	Topics	Readings / Activities
13	*Deep Learning Advanced – CNNs, RNNs, Transformers*	Chapter 21.6 – 21.8
14	*Special Topics in AI*	TBD
15	*Project Presentations*	Final project & presentation

Note: The instructor reserves the right to adjust this schedule as needed.

Assignments & Projects

Homeworks

- **4 total**; best 3 count

- Covers search, probabilistic reasoning, reinforcement learning, ML

Mid-term Exam

- Week 8

- Focus on early modules (search, logic, probability)

Course Project

1. **Research-Oriented** (investigate an AI question, experiments, write-up)

2. **Applied AI** (develop or enhance a real-world AI application)

Milestones:

- **Week 2**: Group formation

- **Week 6**: Proposal

- **Week 11**: Progress Report

- **Weeks 14-15**: Final Presentation & Demo

Grading & Assessment

Assessment Structure

Component	Weight
Homeworks/Assignments	30%
Participation	5%
Mid-term Exam	20%
Course Project	40%
Total	**100%**

Grading & Assessment (Contd.)

Letter Grade Cutoffs

Grade	Percentage
A	80% – 100%
B	70% – 79%
C	60% – 69%
F	< 60%

> *Lowest homework score dropped. You will get out of this course what you put into it!*

Career Opportunities in AI

*"The future is AI. But remember, **you** are the mind behind the machine."*

1. **Research-Oriented Careers**

   ○ Academia, research institutions, think tanks

   ○ Focus on advancing AI theory, algorithms, and applications

2. **Industry & Applied AI**

   ○ Tech companies, startups, consulting firms

   ○ Building AI products, solutions, and services

Career Opportunities in AI (Contd.)

3. **Government & Policy**

   - Regulatory bodies, public sector

   - Shaping AI policy, governance, and ethics

4. **AI for Social Good**

   - Non-profits, NGOs, humanitarian organizations

   - Leveraging AI for sustainable development, social impact

Regardless of the path you choose, AI skills unlock doors to innovation, creativity, and lasting impact.

Key Takeaways

1. **AI's Breadth**

    ○ From logic & search to machine learning & ethics

2. **This Course as a Roadmap**

    ○ Methodical approach to core techniques, hands-on projects

3. **Context Matters**

    ○ Consider resource constraints, ethical frameworks, local impact

4. **Stay Inquisitive**

    ○ Engage with peers, bring your ideas, shape AI for Guyana & beyond

Next Steps

- **Review** the syllabus/README & these slides
- **Read** Chapter 1 (Russell & Norvig) on AI basics, Being readied for Week 2 on search algorithms!
- **HW0**: Released later this week, due in week 4
- **Brainstorm** project directions — research vs. applied AI

Thank you for joining Week 1!
Prepare for an exciting journey into the world of AI.
Send questions anytime to christopher.clarke@uog.edu.gy