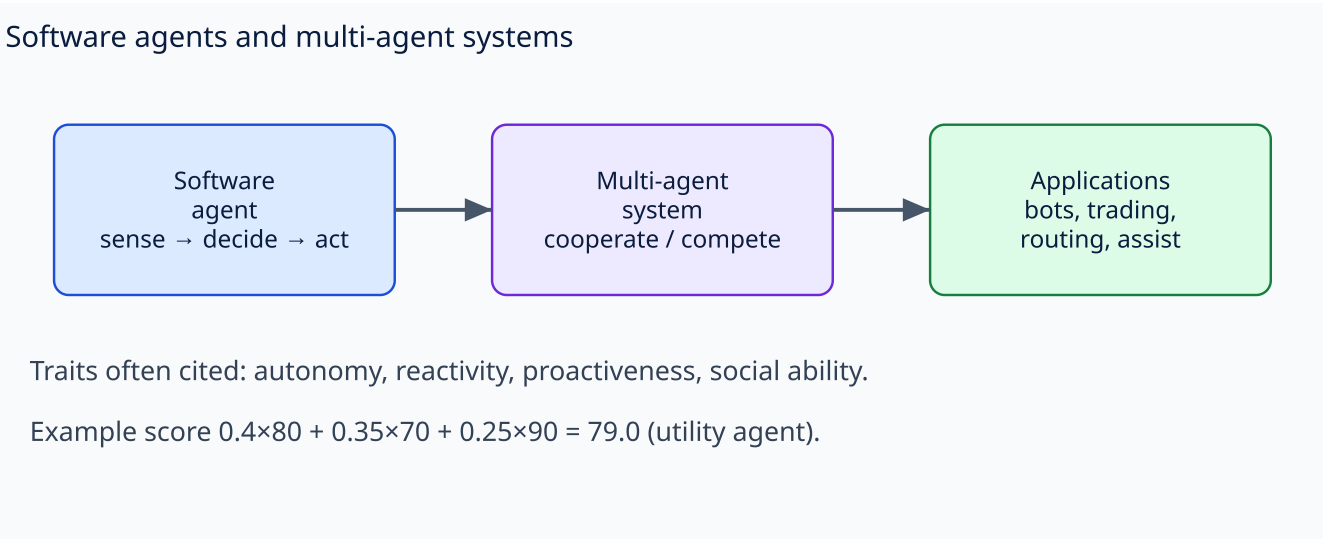
Grade 13 A/L ICT · Lesson 13

13.2 Software Agents and Multi-Agent Systems

Syllabus 13.2. A **software agent** is a program that can sense its environment, decide and act with a degree of **autonomy** to meet goals on behalf of a user or system. **Multi-agent systems (MAS)** have several agents that cooperate, coordinate or compete. Applications include personal assistants, recommendation bots, trading agents, network routing helpers and industrial monitoring.

1. Software agents



From a single agent to multi-agent applications

- **Sense** → **decide** → **act** loop, often continuous.
- Common characteristics: **autonomy**, **reactivity** (respond to change), **proactiveness** (pursue goals), **social ability** (communicate).
- May be simple rule-based or use scored utilities / learning.

> 🧱 **Worked example: Utility agent weights: price 0.40, time 0.35, trust 0.25. Scores 80, 70, 90. Total?**
> Score = 0.40×80 + 0.35×70 + 0.25×90 = **79.0**.

🐍 Software-agent utility score

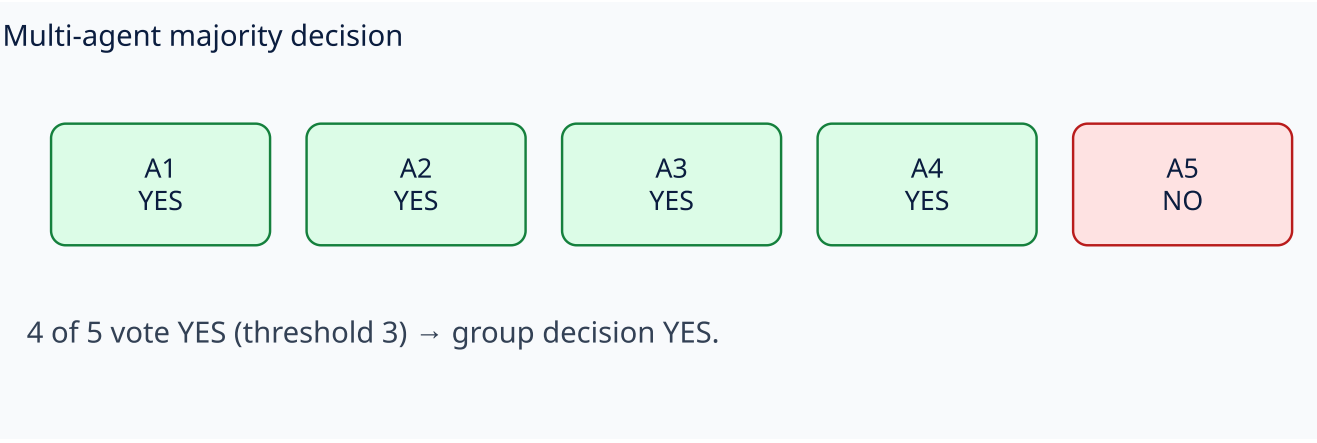
```
w_price, w_time, w_trust = 0.4, 0.35, 0.25
s_price, s_time, s_trust = 80, 70, 90
score = round(w_price*s_price + w_time*s_time + w_trust*s_trust, 1)
print("Agent score:", score)
```

▶ Output

```
Agent score: 79.0
```

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2. Multi-agent systems



Majority vote among five agents

- Several agents share an environment; each has local goals or roles.
- They **cooperate** (team), **coordinate** (plans/messages) or **compete** (markets).
- Need protocols for messages, negotiation and conflict handling.

> 🧮 **Worked example: 5 agents, threshold 3, YES votes = 4. Decision?**
> $4 \geq 3$ → decision **YES**.

🐍 Multi-agent majority vote

```
votes_yes, agents, thresh = 4, 5, 3
decision = "YES" if votes_yes >= thresh else "NO"
print("Votes YES:", votes_yes, "/", agents)
print("Decision:", decision)
```

▶ Output

```
Votes YES: 4 / 5
Decision: YES
```

3. Applications of agent systems

- Personal / chat assistants that schedule and remind.
- E-commerce shopping / price-watch agents.
- Network management and routing helpers.
- Industrial monitoring and alerting agents.
- Simulation and games with many NPC agents.

> 💡 An agent is not “any program” – look for autonomy and a sense–decide–act loop on someone’s behalf.

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🚀 **Beyond the syllabus (2026 update)** *Not required for the exam – read for interest.* In 2026, LLM-powered agents can call tools (search, calendar, code) in loops; multi-agent frameworks assign planner, critic and worker roles. Blockchain oracles and trading bots are other agent-like systems in the news. Interest only – exam focuses on agent characteristics, MAS and classic applications.

Key Words

Software agent – Autonomous program that senses, decides and acts for goals.

Autonomy – Operating with limited direct control.

Reactivity – Responding to changes in the environment.

Proactiveness – Taking initiative to pursue goals.

Social ability – Communicating with other agents or users.

Multi-agent system – System made of multiple interacting agents.

Cooperation – Agents working toward shared goals.

Coordination – Organising actions and messages among agents.

Negotiation – Agents bargaining to reach agreement.

Utility score – Weighted sum used to choose among options.

Personal assistant agent – Helps a user with tasks such as scheduling.

Trading agent – Buys/sells or watches prices under rules.

Sample Q&A

1. Define a software agent.

> **Answer:** Autonomous program that senses, decides and acts for goals.

2. Name four typical agent characteristics.

> **Answer:** Autonomy, reactivity, proactiveness, social ability.

3. What is a multi-agent system?

> **Answer:** Several interacting agents in a shared environment.

4. How can agents interact in an MAS?

> **Answer:** Cooperate, coordinate or compete.

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5. Give three applications of agent systems.

> **Answer:** Assistants; e-commerce/price agents; network or industrial monitoring.

6. Compute the sample utility score 0.40×80 + 0.35×70 + 0.25×90.

> **Answer:** 79.0.

MCQ

1. A software agent mainly

A. senses, decides and acts with autonomy
B. only prints banners
C. only powers a CRT
D. only stores paper files
E. only melts solder

2. Autonomy means the agent

A. has no goals
B. works with limited direct control
C. cannot read input
D. needs a human click every CPU cycle
E. never runs

3. Reactivity means

A. responding to environment changes
B. painting the case
C. deleting the disk
D. banning networks
E. ignoring all sensors

4. A multi-agent system contains

A. exactly one frozen variable
B. only a single LED
C. several interacting agents
D. only a vinyl disk
E. only a paper form

5. Agents that share a team goal mainly

A. never message
B. cooperate
C. only sleep
D. always crash
E. only print

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6. Utility score 0.40×80 + 0.35×70 + 0.25×90 equals

A. 0.0
B. 100.0
C. 50.0
D. 79.0
E. 10.0

7. With 4 YES votes out of 5 and threshold 3 the decision is

A. YES
B. WAIT
C. NO
D. TIE
E. ABORT

8. A price-watch shopping bot is an example of

A. a fountain pen
B. a steam engine
C. a CRT yoke
D. a punch card press
E. an agent application

9. Social ability refers to

A. communicating with users or other agents
B. formatting floppies
C. ignoring messages
D. melting RAM
E. tuning pianos

10. Proactiveness means

A. only reacting once then quitting forever
B. taking initiative toward goals
C. never planning
D. removing sensors
E. banning goals

11. Which term means: “Autonomous program that senses, decides and acts for goals”?

A. Coordination
B. Reactivity
C. Personal assistant agent
D. Software agent
E. Multi-agent system

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12. Which term means: “Operating with limited direct control”?

A. Proactiveness
B. Negotiation
C. Cooperation
D. Trading agent
E. Autonomy

13. Which term means: “Responding to changes in the environment”?

A. Coordination
B. Social ability
C. Software agent
D. Utility score
E. Reactivity

14. Which term means: “Taking initiative to pursue goals”?

A. Multi-agent system
B. Proactiveness
C. Negotiation
D. Autonomy
E. Personal assistant agent

15. Which term means: “Communicating with other agents or users”?

A. Utility score
B. Cooperation
C. Trading agent
D. Social ability
E. Reactivity

16. Which term means: “System made of multiple interacting agents”?

A. Proactiveness
B. Personal assistant agent
C. Multi-agent system
D. Software agent
E. Coordination

17. Which term means: “Agents working toward shared goals”?

A. Negotiation
B. Trading agent
C. Autonomy
D. Cooperation
E. Social ability

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18. Which term means: “Organising actions and messages among agents”?

A. Reactivity
B. Utility score
C. Coordination
D. Multi-agent system
E. Software agent

19. Which term means: “Agents bargaining to reach agreement”?

A. Cooperation
B. Autonomy
C. Negotiation
D. Personal assistant agent
E. Proactiveness

20. Which term means: “Weighted sum used to choose among options”?

A. Reactivity
B. Trading agent
C. Coordination
D. Social ability
E. Utility score

Structured Questions

1. Define a software agent and list four characteristics. *(2 marks)*

> Definition; autonomy, reactivity, proactiveness, social ability.

2. Explain multi-agent systems and how agents may interact. *(2 marks)*

> Definition; cooperate / coordinate / compete.

3. Describe three applications of agent systems. *(2 marks)*

> Three clear application areas.

4. Calculate the utility score for weights 0.40, 0.35, 0.25 and scores 80, 70, 90. *(2 marks)*

> 79.0 with working.

5. Using votes YES=4, agents=5, threshold=3, state the group decision and why. *(2 marks)*

> YES because 4≥3.

Summary

- Agents sense, decide and act with autonomy.

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- Traits: autonomy, reactivity, proactiveness, social ability.
- MAS: many agents cooperate, coordinate or compete.
- Applications: assistants, commerce, networks, industry.
- Utility scores and votes are simple decision methods.

MCQ answer key – 13.2

1. **A** – Sense–decide–act.
2. **B** – Limited direct control.
3. **A** – Respond.
4. **C** – Many agents.
5. **B** – Cooperation.
6. **D** – Weighted sum.
7. **A** – 4≥3 → YES.
8. **E** – E-commerce agent.
9. **A** – Communication.
10. **B** – Initiative.
11. **D** – Software agent – Autonomous program that senses, decides and acts for goals.
12. **E** – Autonomy – Operating with limited direct control.
13. **E** – Reactivity – Responding to changes in the environment.
14. **B** – Proactiveness – Taking initiative to pursue goals.
15. **D** – Social ability – Communicating with other agents or users.
16. **C** – Multi-agent system – System made of multiple interacting agents.
17. **D** – Cooperation – Agents working toward shared goals.
18. **C** – Coordination – Organising actions and messages among agents.
19. **C** – Negotiation – Agents bargaining to reach agreement.
20. **E** – Utility score – Weighted sum used to choose among options.

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