Requirement Engineering

Graphical and Mathematical Specifications

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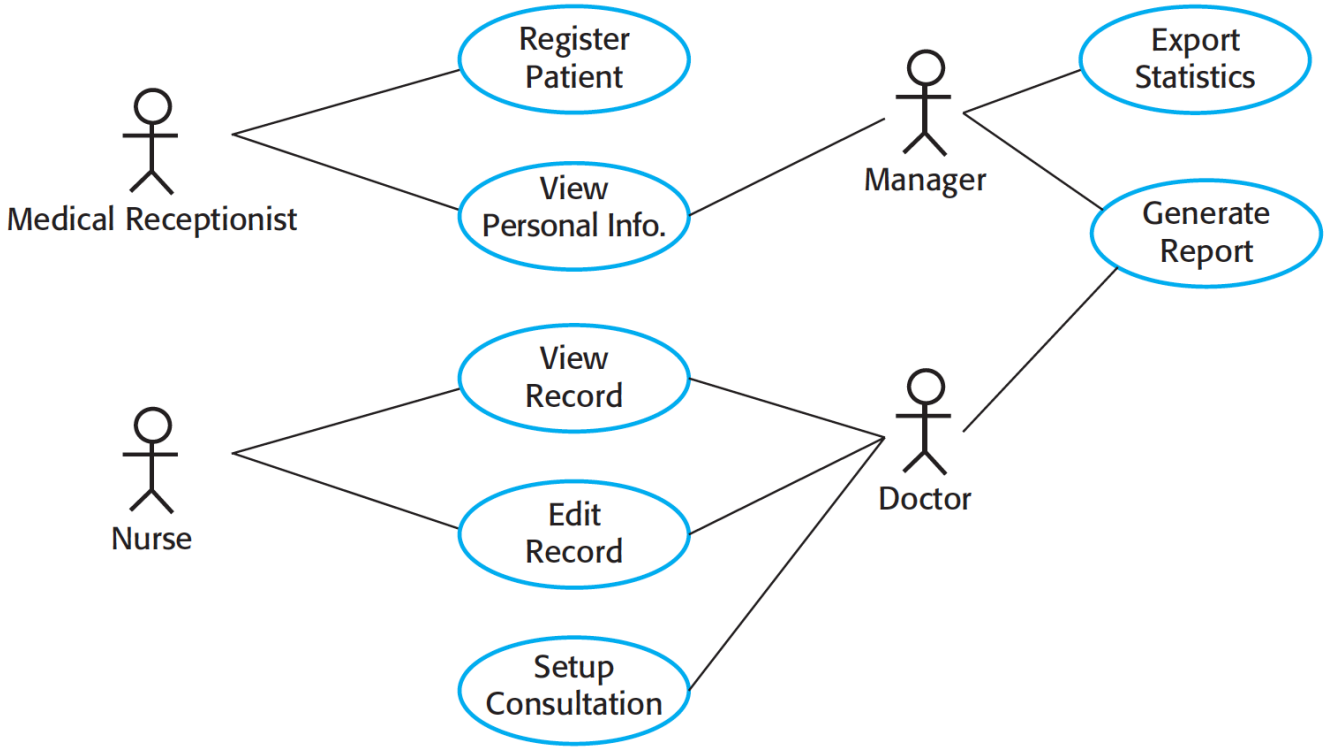
Ways of Writing Requirement Specifications

- Natural language sentences
- Structured natural language
- **Graphical notations**
- Mathematical specifications

Use Cases

- A fundamental feature of the Unified Modeling Language (UML)
- Identifies the actors involved in an interaction and names the type of interaction
- Supplemented by additional information describing the interaction with the system
- The additional information may be a textual description or one or more graphical models such as UML sequence or state charts

Example Use Cases for the MHC-PPMS



Texual Description: Setup consultation allows two or more doctors, working in different offices, to view the same record at the same time. One doctor initiates the consultation by choosing the people involved from a drop-down menu of doctors who are online. The patient record is then displayed on their screens but only the initiating doctor can edit the record. In addition, a text chat window is created to help coordinate actions. It is assumed that a phone conference for voice communication will be separately set up.

Ways of Writing Requirement Specifications

- Natural language sentences
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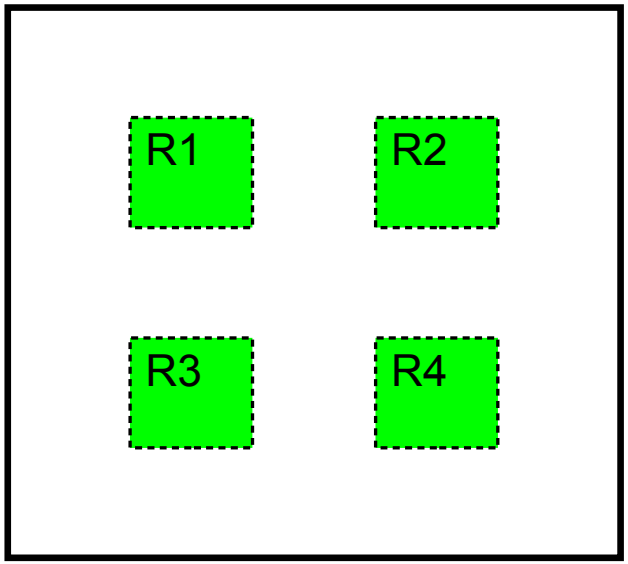
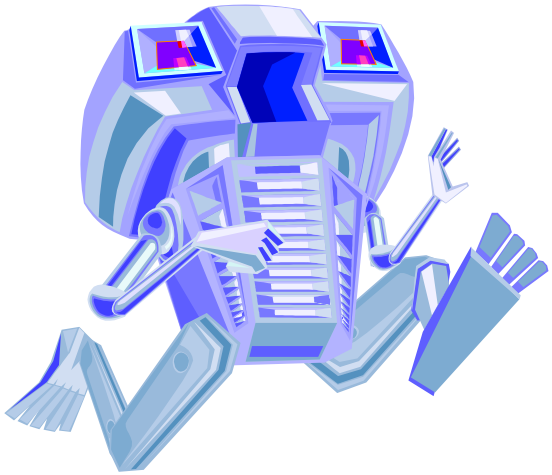
- Graphical notations
- **Mathematical specifications**

Specification Language





Should be expressive to capture temporal relationships among the events

Example: Visit area R_2, then area R_3, then area R_4, and finally, return and remain in region R_1 while avoiding areas R_2 and R_3

Linear Temporal Logic

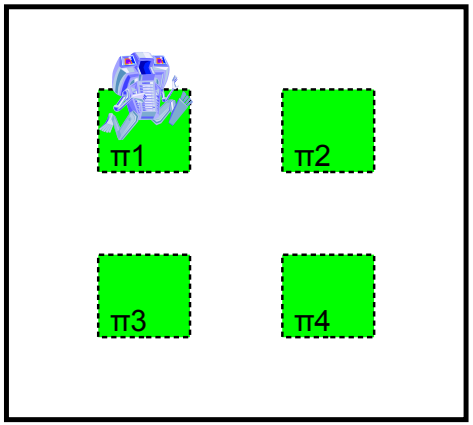
Linear Temporal Logic (LTL)

LTL Grammar:

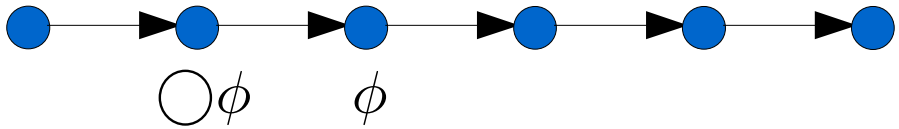
$$\phi ::= \pi \mid \neg\phi \mid \phi \wedge \phi \mid \bigcirc \phi \mid \Box \phi \mid \Diamond \phi \mid \phi \,\mathcal{U}\, \phi$$

π - atomic proposition

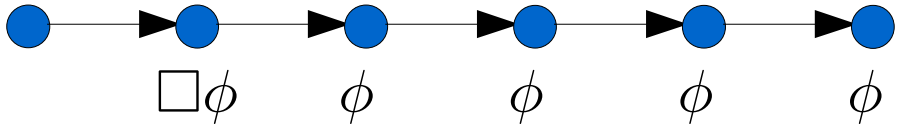
Example: π_1 - The robot is in Room 1



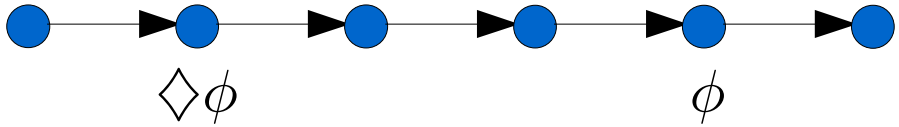
(next)



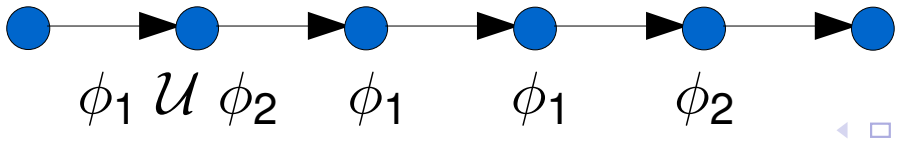
(always)



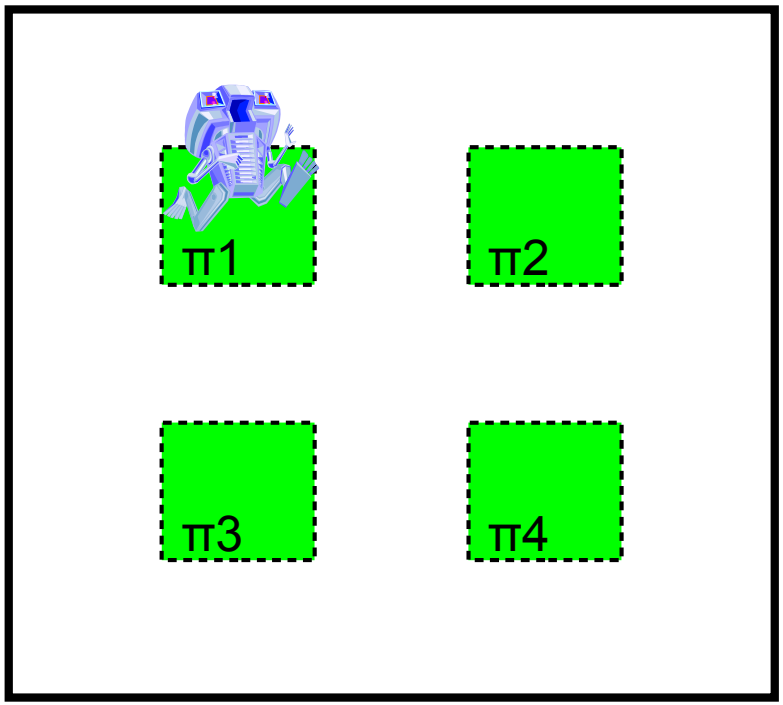
(eventually)



(until)



Examples of LTL Specifications



1. **Reachability**
   $\varphi = \Diamond \pi_2$
2. **Coverage**
   $\varphi = \Diamond \pi_2 \wedge \Diamond \pi_3 \wedge \Diamond \pi_4$
3. **Sequencing**
   $\Diamond(\pi_2 \wedge \Diamond \pi_3)$
4. **Reachability with avoidance**
   $(\neg \pi_2 \wedge \neg \pi_3)\, \mathcal{U}\, \pi_4$
5. **Recurrent sequencing**
   $\Box\Diamond(\pi_2 \wedge \Diamond \pi_3)$

Visit area R_2, then area R_3, then area R_4, and finally, return and remain in region R_1 while avoiding areas R_2 and R_3

$$\varphi = \Diamond(\pi_2 \wedge \Diamond(\pi_3 \wedge \Diamond(\pi_4 \wedge (\neg \pi_2 \wedge \neg \pi_3)\, \mathcal{U}\, \Box \pi_1)))$$

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