Possible axioms of BDI logic

- GOAL(□) BEL(□)
  "belief-goal compatibility"
- INTEND(□) GOAL(□)
  "goal-intention compatibility"
- INTEND(does(e)) does(e)
  "intention leading to action"
- INTEND(□) BEL(INTEND(□))
- GOAL(□) BEL(GOAL(□))
- INTEND(□) GOAL(INTEND(□))

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How to get Belief-Goal Compatibility?

- Define a relation ◁ on worlds:
  w"◁ w' □ fullpaths(w") □ fullpaths(w')
- B-G condition:
  □w' □ B(w,t) □w" □ G(w,t) : w"◁ w'
- Under B-G condition it holds that:
  ⊨GOAL(□) BEL(□)

  for □ = optional(□)

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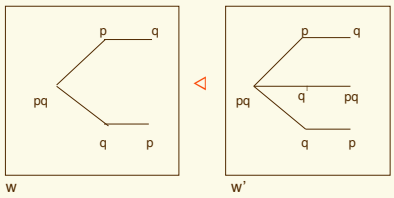
◁ on worlds



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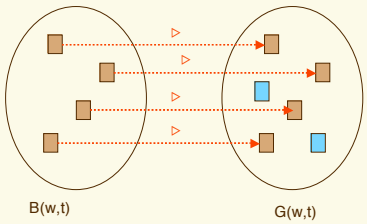
B-G condition



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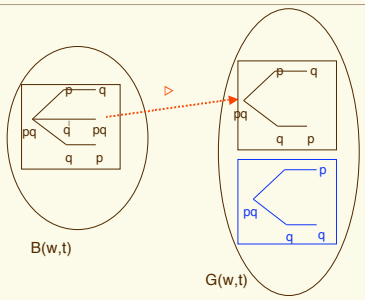
B-G condition : example



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Goal-Intention compatibility

- Goal-Intention compatibility is obtained in a similar fashion:
- G-I condition:
  □w' □ G(w,t) □w" □ I(w,t) : w"◁ w'
- Under G-I condition it holds that:
  ⊨INTEND(□) GOAL(□)

  for □ = optional(□)

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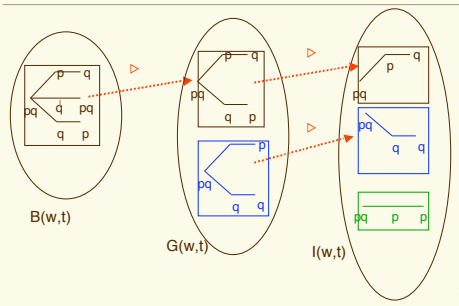
B-G + G-I: intention is choice!



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Possible axioms of BDI (ctd)

- done(e) BEL(done(e))
  "awareness of primitive events
- INTEND(□) inevitable□(¬INTEND(□))
  "no infinite deferral"
- INTEND(inevitable□□)
  inevitable(INTEND(inevitable□□) U BEL(□))
  "blindly committed agent"

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Possible axioms of BDI (ctd)

- INTEND(inevitable□□)
  inevitable(INTEND(inevitable□□) U
  (BEL(□) ¬BEL(optional□□)))
  "single-minded committed agent"
- INTEND(inevitable□□)
  inevitable(INTEND(inevitable□□) U
  (BEL(□) ¬GOAL(optional□□)))
  "open minded committed agent"

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The Little Nell Story (McDermott, Cohen & Levesque)

- problem: agent gives up too soon: it abandons its plan just because it believes it will be successful
- Cohen & Levesque: Little Nell problem occurs in *linear-time* variant of BDI logic satisfying the 'reasonable' principles that
  - (1) INTEND(□) BEL(□□) ('confidence')
  - (2) BEL(□) ¬INTEND(□) ('drop fulf. intention')

[INTEND(□□) □ BEL(□□□) □ BEL(□□) □ ¬INTEND(□□)]

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Little Nell in BDI

- In R&G's BDI logic this would be expressed roughly as:
  - INTEND(inevitable□□)
    inevitable(INTEND(inevitable□□) U
    BEL(optional□□))
  - I.e., since the agent believes that *there is a way* (by performing its plan) to eventually reaching the goal □, it drops its intention to perform the plan to achieve eventually □
  - This property does not follow in BDI logic!
    Ok!

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