Fundamentals of Artificial Intelligence

Laboratory

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Academic Year 2021/2022

Exercise 12.1

Consider (normal) modal logics.
Let **IsBlue(Pen)**, **IsInPocket(Pen)** be possible facts, let **Anne**, **Jim** be agents and let $\mathbf{K_{Anne}}$, $\mathbf{K_{Jim}}$ denote the modal operators "Anne knows that..." and "Jim knows that..." respectively.
For each of the following facts, say if it is true or false.

(a) If $K_{Anne}\text{IsBlue(Pen)}$ and $K_{Anne}(\text{IsBlue(Pen)} \Rightarrow K_{Jim}\text{IsBlue(Pen)})$ hold,
then $K_{Anne}K_{Jim}\text{IsBlue(Pen)})$ holds

(b) If $K_{Jim}\text{IsBlue(Pen)}$ and $\text{IsBlue(Pen)} \Leftrightarrow \text{IsInPocket(Pen)}$ hold,
then $K_{Jim}\text{IsInPocket(Pen)}$ holds

(c) If $\neg K_{Anne}\text{IsBlue(Pen)}$ holds, then $K_{Anne}\neg\text{IsBlue(Pen)}$ holds

(d) If $K_{Anne}\neg\text{IsBlue(Pen)}$ holds, then $\neg K_{Anne}\text{IsBlue(Pen)}$ holds

Exercise 12.2

Consider (normal) modal logics.
Let **IsOn(Switch)**, **IsRunning(Engine)** be possible facts, let **Susie**, **Bill** be agents and let $\mathbf{K_{Susie}}$, $\mathbf{K_{Bill}}$ denote the modal operators “Susie knows that...” and “Bill knows that...” respectively.
For each of the following facts, say if it is true or false.

(a) If $K_{Susie}(IsOn(Switch) \lor IsRunning(Engine))$ holds,
then $K_{Susie}IsOn(Switch) \lor K_{Susie}IsRunning(Engine)$ holds

(b) If $K_{Bill}IsOn(Switch)$ and $IsOn(Switch) \Leftrightarrow IsRunning(Engine)$ hold,
then $K_{Bill}IsRunning(Engine)$ holds

(c) If $K_{Susie}IsOn(Switch)$ and $K_{Susie}(IsOn(Switch) \Rightarrow K_{Bill}IsOn(Switch))$ hold,
then $K_{Susie}K_{Bill}IsOn(Switch))$ holds

(d) If $K_{Susie}(IsOn(Switch) \land IsRunning(Engine))$ holds,
then $K_{Susie}IsOn(Switch) \land K_{Susie}IsRunning(Engine)$ holds

Exercise 12.3

Given:
• a set of basic concepts: {Person, Male, Engineer, Doctor}
• a set of relations: {hasChild}
with their obvious meaning.
Write a T-box in ALCN description logic defining the following concepts.

(a) Female, Man, Woman (with their genetic meaning)

Female ≡ ¬Male; **Man ≡ Person ∧ Male;** **Woman ≡ Person ∧ Female**

(b) femaleEngineerWithoutChildren: female engineer with no children

femaleEngineerWithoutChildren ≡ Woman ∧ Engineer ∧ ¬∃hasChild.Person

(c) fatherOfFemaleEngineer: father of at least three female engineers

fatherOfFemaleEngineer ≡ Man ∧ (≥ 3)hasChild(Female ∧ Engineer)

(d) motherOfEngineersOrDoctors: woman whose children are all doctors or engineers

motherOfEngineersOrDoctors ≡ Woman ∧ ∀hasChild(Doctor ∨ Engineer)

Exercise 12.4

Given:
• a set of basic concepts: {Person, Dog, Cat, Male, Female}
• a set of relations: {hasChild, hasPet}
with their standard meaning ("hasChild" refers also to animals).
Write a T -box in ALCN description logic defining the following concepts

(a) DogLover: a person with at least two dogs

$$\textbf{DogLover} \equiv \textbf{Person} \wedge (\geq 2)\textbf{hasPet.Dog}$$

(b) ChildlessMaleCat: childless male cat

$$\textbf{ChildlessMaleCat} \equiv \textbf{Cat} \wedge \textbf{Male} \wedge \neg\exists.\textbf{hasChild.Cat}$$

(c) PersonWithFemaleDogs: a person with female dogs

$$\textbf{PersonWithFemaleDogs} \equiv \textbf{Person} \wedge \exists\textbf{hasPet}(\textbf{Dog} \wedge \textbf{Female})$$

(d) WomanWithDogsOrCats: woman whose pets are all dogs or cats

$$\textbf{WomanWithDogsOrCats} \equiv \textbf{Person} \wedge \textbf{Female} \wedge \forall\textbf{hasPet}(\textbf{Dog} \vee \textbf{Cat})$$

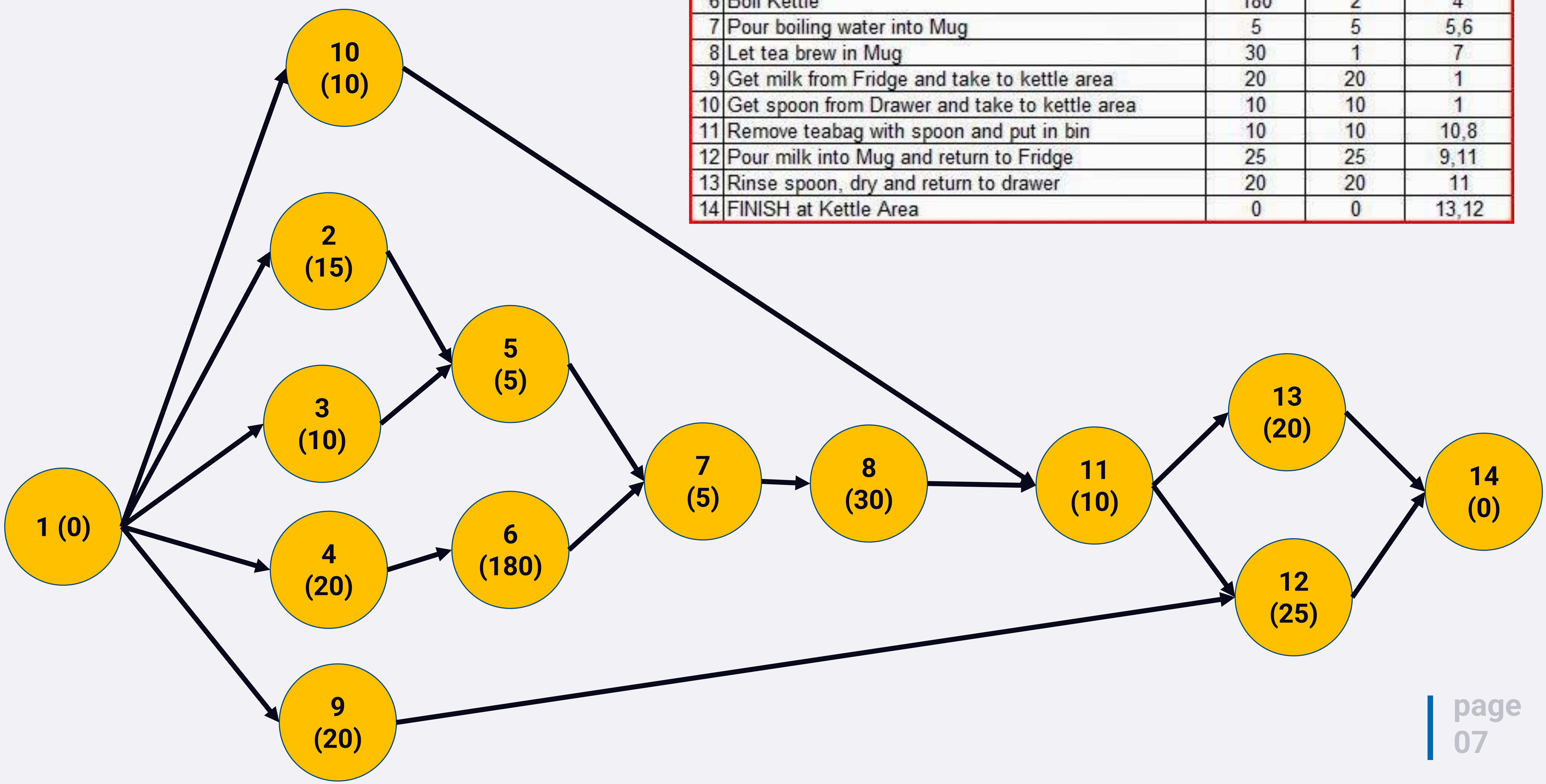
Exercise 12.5

- **Making a cup of tea**
  The tasks, durations, effort and task predecessors are listed in the table below.
  a. What task numbers are on the critical path for the basic network?
  b. If there is no consideration of over allocated resources, what is the earliest finish time of your Project?

PROJECT - Cup of Tea - Task List				
#	Description	Duration (secs)	Effort (secs)	Pre-decessor #
1	START at Kettle Area	0	0	None
2	Get Clean Mug from Cupboard, take to kettle area	15	15	1
3	Get Teabag from container, take to kettle area	10	10	1
4	Fill kettle with enough water and return to kettle area	20	20	1
5	Put teabag into Mug	5	5	2,3
6	Boil Kettle	180	2	4
7	Pour boiling water into Mug	5	5	5,6
8	Let tea brew in Mug	30	1	7
9	Get milk from Fridge and take to kettle area	20	20	1
10	Get spoon from Drawer and take to kettle area	10	10	1
11	Remove teabag with spoon and put in bin	10	10	10,8
12	Pour milk into Mug and return to Fridge	25	25	9,11
13	Rinse spoon, dry and return to drawer	20	20	11
14	FINISH at Kettle Area	0	0	13,12

Exercise 12.5

PROJECT - Cup of Tea - Task List				
#	Description	Duration (secs)	Effort (secs)	Pre-decessor #
1	START at Kettle Area	0	0	None
2	Get Clean Mug from Cupboard, take to kettle area	15	15	1
3	Get Teabag from container, take to kettle area	10	10	1
4	Fill kettle with enough water and return to kettle area	20	20	1
5	Put teabag into Mug	5	5	2,3
6	Boil Kettle	180	2	4
7	Pour boiling water into Mug	5	5	5,6
8	Let tea brew in Mug	30	1	7
9	Get milk from Fridge and take to kettle area	20	20	1
10	Get spoon from Drawer and take to kettle area	10	10	1
11	Remove teabag with spoon and put in bin	10	10	10,8
12	Pour milk into Mug and return to Fridge	25	25	9,11
13	Rinse spoon, dry and return to drawer	20	20	11
14	FINISH at Kettle Area	0	0	13,12



Exercise 12.6

- Consider a simple case of resource allocation that contains 12 uninterruptible tasks, each with fixed duration and demand. These tasks need to be scheduled on a single renewable resource that has a capacity of eight units.

Task	Duration	Demand	Successors
1	1	4	4
2	2	2	5
3	2	3	
4	6	3	
5	3	2	
6	6	3	12
7	1	1	8, 9, 10
8	3	2	11
9	3	2	12
10	4	1	12
11	2	2	12
12	4	2	