

# COMP417 Artificial Intelligence

## Exercise Set 3

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15 May 2018

### Exercise 1

#### Sentence A

$Smoke$	$Smoke \implies Smoke$
$true$	$true$
$false$	$true$

The sentence is *valid* (reflexive property, see truth table).

#### Sentence B

$Smoke$	$Fire$	$Smoke \implies Fire$
$true$	$true$	$true$
$false$	$true$	$true$
$false$	$false$	$true$
$true$	$false$	$false$

The sentence is *satisfiable* (see truth table).

#### Sentence C

Let  $B \equiv (Smoke \implies Fire)$  and  $C \equiv (\neg Smoke \implies \neg Fire)$ .

$Smoke$	$Fire$	$B$	$C$	$B \implies C$
$true$	$true$	$true$	$true$	$true$
$false$	$true$	$true$	$false$	$false$
$false$	$false$	$true$	$true$	$true$
$true$	$false$	$false$	$true$	$true$

The sentence is *satisfiable* (see truth table).

#### Sentence D

$Fire \vee \neg Fire \equiv true$  (law of excluded middle), therefore the sentence is *valid*:

$$\begin{aligned} Smoke \vee Fire \vee \neg Fire &\equiv \\ Smoke \vee true &\equiv \\ true & \end{aligned}$$

### Sentence E

$$\begin{aligned}((Smoke \wedge Heat) \implies Fire) &\iff ((Smoke \implies Fire) \vee (Heat \implies Fire)) \equiv \\(\neg(Smoke \wedge Heat) \vee Fire) &\iff ((Smoke \implies Fire) \vee (Heat \implies Fire)) \equiv \\(\neg Smoke \vee \neg Heat \vee Fire) &\iff ((Smoke \implies Fire) \vee (Heat \implies Fire)) \equiv \\(\neg Smoke \vee \neg Heat \vee Fire) &\iff ((\neg Smoke \vee Fire) \vee (\neg Heat \vee Fire)) \equiv \\(\neg Smoke \vee \neg Heat \vee Fire) &\iff (\neg Smoke \vee \neg Heat \vee Fire) \equiv \\&true\end{aligned}$$

Therefore the sentence is *valid*.

### Sentence F

$$\begin{aligned}(Smoke \implies Fire) \implies ((Smoke \wedge Heat) \implies Fire) &\equiv \\(\neg Smoke \vee Fire) \implies ((Smoke \wedge Heat) \implies Fire) &\equiv \\(\neg Smoke \vee Fire) \implies (\neg(Smoke \wedge Heat) \vee Fire) &\equiv \\ \neg(\neg Smoke \vee Fire) \vee (\neg(Smoke \wedge Heat) \vee Fire) &\equiv \\(Smoke \wedge \neg Fire) \vee (\neg(Smoke \wedge Heat) \vee Fire) &\equiv \\(Smoke \wedge \neg Fire) \vee \neg Smoke \vee \neg Heat \vee Fire &\equiv \\((Smoke \vee \neg Smoke) \wedge (\neg Fire \vee \neg Smoke)) \vee \neg Heat \vee Fire &\equiv \\(true \wedge (\neg Fire \vee \neg Smoke)) \vee \neg Heat \vee Fire &\equiv \\ \neg Fire \vee \neg Smoke \vee \neg Heat \vee Fire &\equiv \\(\neg Fire \vee Fire) \vee \neg Smoke \vee \neg Heat &\equiv \\true \vee \neg Smoke \vee \neg Heat &\equiv \\&true\end{aligned}$$

Therefore the sentence is *valid*.

### Sentence G

$$\begin{aligned}Big \vee Dumb \vee (Big \implies Dumb) &\equiv \\Big \vee Dumb \vee \neg Big \vee Dumb &\equiv \\(Big \vee \neg Big) \vee (Dumb \vee Dumb) &\equiv \\true \vee Dumb &\equiv \\&true\end{aligned}$$

Therefore the sentence is *valid*.

## Sentence H

$$\begin{aligned}(Big \wedge Dumb) \vee \neg Dumb &\equiv \\(Big \vee \neg Dumb) \wedge (Dumb \vee \neg Dumb) &\equiv \\ \neg Dumb \vee Big &\equiv \\ Dumb \implies Big\end{aligned}$$

<i>Dumb</i>	<i>Big</i>	<i>Dumb</i> $\implies$ <i>Big</i>
<i>true</i>	<i>true</i>	<i>true</i>
<i>false</i>	<i>true</i>	<i>true</i>
<i>false</i>	<i>false</i>	<i>true</i>
<i>true</i>	<i>false</i>	<i>false</i>

Therefore the sentence is *satisfiable*.