# Module 3 Practice Quiz

**Due** No due date **Points** 10 **Questions** 10
**Available** after Feb 6 at 12am **Time Limit** None
**Allowed Attempts** Unlimited

Take the Quiz Again

## Attempt History

| | Attempt | Time | Score |
|---|---|---|---|
| **KEPT** | Attempt 2 | 9 minutes | 10 out of 10 |
| **LATEST** | Attempt 2 | 9 minutes | 10 out of 10 |
| | Attempt 1 | less than 1 minute | 3.5 out of 10 |

Submitted Mar 1 at 8:50pm

### Question 1

1 / 1 pts

Find all stable models of the following clingo program.

p :- not q.

q :- not p.

r :- not p.

r :- q.

- [ ] {p, q, r}

Correct!

- [x] {q, r}

The first 2 rules "p :- not q." and "q :- not p." together means we choose exactly one atom from the set {p, q}.

The last 2 rules "r :- not p." and "r :- q." together means that we believe r if p is not true or q is true.

Thus there should be 2 stable models below.

1. {p}
2. {q, r}

Correct!

- [x] {p}

The first 2 rules "p :- not q." and "q :- not p." together means we choose exactly one atom from the set {p, q}.

The last 2 rules "r :- not p." and "r :- q." together means that we believe r if p is not true or q is true.

Thus there should be 2 stable models below.

1. {p}
2. {q, r}

- [ ] {p, r}

- [ ] $\Phi$

## Question 2

**1 / 1 pts**

Which of the statements is true about the minimal model(s) of formula F and G?

Correct!

- (●) If (F→G)∧(G→F) is a tautology under propositional logic, then the minimal models of F are exactly the same as the minimal models of G.

"(F→G)∧(G→F) is a tautology" means that it is satisfied by all interpretations. Thus, for any interpretation I, I must entail both F→G and G→F, in other words, I satisfies F iff I satisfies G. It means that the models of F are exactly the models of G, consequently, the minimal models of F are exactly the minimal models of G.

- If the minimal models of F are exactly the same as the minimal models of G, then F and G are equivalent under propositional logic.
- If the minimal models of F are exactly the same as the minimal models of G, then the models of F are exactly the same as the models of G.
- If F entails G, then the minimal models of F are exactly the same as the minimal models of G.

## Question 3

**1 / 1 pts**

The propositional image of a clingo program consists of the instances of its rules rewritten as propositional formulas. Which option is equivalent to the propositional image of the following clingo program?

a(-1..0)

b(X**2) :- a(X)

- $a(-1) \vee a(0)$
  $b(-2) \leftarrow a(-1)$
  $b(0) \leftarrow a(0)$
- $a(-1) \vee a(0)$
  $b(1) \leftarrow a(-1)$
  $b(0) \leftarrow a(0)$

Correct!

$a(-1) \wedge a(0)$
$b(1) \leftarrow a(-1)$
$b(0) \leftarrow a(0)$

The first rule "a(-1..0)" is a shorthand to say "a(X) is true for all X from -1 to 0". Thus its propositional image is "$a(-1) \wedge a(0)$".

The second rule will be always true if a(X) is false, thus we only need to write down the propositional rules where a(X) is true --- that is X is -1 or X is 0. Also note that X**2 means X to the power of 2. Thus the propositional image for the second rule is

$b(1) \leftarrow a(-1)$

$b(0) \leftarrow a(0)$

$a(-1) \wedge a(0)$
$b(-1^{**}2) - a(-1)$
$b(0^{**}2) \leftarrow a(0)$

## Question 4

**1 / 1 pts**

Which option is equivalent to the following clingo program?

p(X\Y, X**|X-Y|) :- X=1..2, Y=2..3.

Correct!

p(1,1). p(0,1). p(2,2).

X\Y computes the remaining number when we divide X by Y.

|X-Y| computes the absolute value of X minus Y.

X**|X-Y| computes X to the power of |X-Y|.

When X=1, Y=1, the equivalent clingo rule is

p(0, 1).

And you can find the other propositional formulas in the same way.

- p(1..2, 2..3).
- p(0,1). p(1,1). p(0,2).
- p(1,1; 1,2).

## Question 5

**1 / 1 pts**

Which of the following formulas or sets of formulas are equivalent under propositional logic (that is, they have the same models)? Choose all that apply.

Correct!

- [x] $p \wedge q \leftarrow r$ and $\{p \leftarrow r, q \leftarrow r\}$

There are 2^3=8 interpretations and you can check that interpretation I satisfies the former iff I satisfies the latter.

Correct!

- [x] $p \leftarrow p$ and $q \vee \neg q$

There are 2^2=4 interpretations and all of them are the models of the both formulas.

Correct!

- [x] $p \leftarrow q \vee r$ and $\{p \leftarrow q, p \leftarrow r\}$

There are 2^3=8 interpretations and you can check that interpretation I satisfies the former iff I satisfies the latter.

Correct!

- [x] $\{p \leftarrow p, q\}$ and $q$

There are 2^2=4 interpretations and the models of the former are

{q}, {p, q}

which are also the models of the latter.

{p ← q, q ← r} and p ← r

## Question 6

1 / 1 pts

Which of the following formulas have the same stable models? Choose all that apply.

p ← ¬q and q ← ¬p

Correct!

⊥ ← p and ¬p

The stable model of the former is { }, i.e., the empty set and the stable model of the latter is also { }.

Correct!

$p \leftarrow \neg p$ and $\bot$

There is no stable model for both of them.

p ← ¬q and p ∨ q

## Question 7

1 / 1 pts

Which of the following terms represent an empty set of values? Choose all that apply.

Correct!

6..5

This term represent an empty set of values since it means "the set of all integers X such that $6 \leq X \leq 5$".

2**(-2)

Correct!

- [x] a..(a+1)

This term represent an empty set of values since the ".." operator can only be applied to integers.

## Question 8

1 / 1 pts

What is the stable model of the following program?

p ← ¬q,

q ← ¬r

- ( ) {p, q}
- ( ) { } (empty set)
- ( ) {r}
- (•) {q} — Correct!

This is the only stable model. First, r must be false since there is no rule to derive r. Second, q must be true due to the second rule. Finally, p cannot be true. Overall, the stable model is {q}.

- ( ) {p, q, r}
- ( ) {p, r}
- ( ) {p}
- ( ) {q, r}

## Question 9

1 / 1 pts

Which option is correct about the stable models of the following propositional rule?

p←¬¬p

- It has no stable model.
- Its stable model is ∅.
- Its stable model is {p}.

Correct!

- Its stable models are ∅ and {p}.

There are only 2 interpretations ∅ and {p}. You may follow the definition of stable model to (i) construct the reduct of the ASP program with respect to each of the 2 interpretations and (ii) check whether the minimal model of each reduct is the same as the corresponding interpretation.

Consider $I = \varnothing$ and let P denote the ASP program. Then its reduct w.r.t. I (denoted by $P^I$) is shown below.

$p \leftarrow \bot$

Its minimal model is ∅, which is exactly I. Thus I is a stable model of P.

You also need to check for $I = \{p\}$.

## Question 10

1 / 1 pts

True or False? Every positive program has a model.

- False

Correct!

True

This is true since, for any positive program P, the set of all atoms must satisfy P.