Practice Questions for Graph Theory

Representation, Search Algorithms, and Variants for Problem Solving

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Feb '25

1 Predicate No. `290e`

Well Formed Expression $\forall X(\text{student?}(X) \rightarrow \exists Y(\text{book?}(Y) \wedge \text{has\_read?}(X, Y)))$

Interpretation in Natural Language Every student has read some book.

2 Predicate No. `d9e2`

Well Formed Expression $\forall \mathit{Feature}(\exists \mathit{Library}(\text{depends\_on?}(\mathit{Feature}, \mathit{Library})) \rightarrow (\neg\text{compatible\_with?}(\mathit{Feature}, \mathit{Library}) \wedge \text{deprecated?}(\mathit{Library})))$

Interpretation in Natural Language Every feature depends upon some incompatible and deprecated library.

3 Predicate No. `4f1g`

Well Formed Expression $\exists \mathit{TranscriptionFactor} \exists \mathit{ActivatorProtein} \forall \mathit{TargetGene}((\text{transcription\_fact}$ $\text{activates?}(\mathit{ActivatorProtein}, \mathit{TargetGene})) \wedge \neg\text{co\_located?}(\mathit{TranscriptionFactor}, \mathit{TargetGene}))$

Interpretation in Natural Language A protein may activate all genes that aren't co-located with a specific transcription factor.

4 Predicate No. `3d4e`

Well Formed Expression $\exists Fluid \exists Pipe(\neg\text{incompressible?}(Fluid) \wedge \text{flows\_through?}(Fluid, Pipe) \rightarrow \text{pressure\_drop?}(Pipe))$

Interpretation in Natural Language If a compressible fluid flows through a pipe, then the pipe experiences pressure drop.

5 Predicate No. `9i0j`

Well Formed Expression $\exists Gene\ \exists Protein\ \forall DNARegion\ ((\text{inhibits\_proliferation?}(Gene) \wedge \text{binds\_to?}(Protein, DNARegion)) \rightarrow \neg\text{regulates\_binding?}(Gene, Protein, DNARegion))$

Interpretation in Natural Language A gene that stops cell growth and a protein exist where the gene never regulates the protein binding to DNA.

6 Predicate No. `6q7r`

Well Formed Expression $\forall System \forall VibrationDamper \forall StandardComponent(\text{vibration\_sensitive?}(S$ $(\text{vibration\_damper?}(VibrationDamper) \wedge \neg\text{replaced\_by?}(StandardComponent, VibrationDamper)))$

Interpretation in Natural Language In a vibration-sensitive system, a vibration damper is used without replacing any standard component.

7 Predicate No. `9j0k`

Well Formed Expression $\exists Reactor \forall Condition(\neg\text{cstr?}(Reactor) \vee (\text{high\_pressure?}(Condition) \rightarrow \text{suitable\_for?}(Reactor, Condition)))$

Interpretation in Natural Language A reactor exists that either isn't a continuous stirred-tank reactor (CSTR), or is suitable for all high pressure conditions.

8 Predicate No. `2e3f`

Well Formed Expression $\forall Protein(\neg\text{membrane\_bound\_receptor?}(Protein) \vee \exists Molecule(\text{interacts\_with?}(Protein, Molecule) \wedge \neg\text{signaling\_molecule?}(Molecule)))$

Interpretation in Natural Language Every protein is either not a membrane-bound receptor, or it interacts with a molecule that is not a signaling molecule.

9 Predicate No. `f3a9`

Well Formed Expression $\forall Course \exists Module(\neg\text{mandatory?}(Course) \vee (\text{advanced?}(Module) \rightarrow \neg\text{requires?}(Course, Module)))$

Interpretation in Natural Language Either a course is optional, or it doesn't require advanced modules.

10 Predicate No. `6d7e`

Well Formed Expression $\exists GrowthProtein \forall Receptor(\text{receptor?}(Receptor) \rightarrow (\text{growth\_protein?}(GrowthProtein) \vee \neg\text{inhibits?}(GrowthProtein, Receptor)))$

Interpretation in Natural Language A protein involved in cell growth exists that does not inhibit any receptor protein.

11 Predicate No. `1b2c`

Well Formed Expression $\exists Process\ \forall Material\ (\neg\text{corrosive?}(Material) \wedge (\text{high\_temperature?}(Process) \rightarrow \text{compatible?}(Process, Material)))$

Interpretation in Natural Language A high-temperature process exists that is compatible with all non-corrosive materials.

12 Predicate No. `2b91`

Well Formed Expression $\exists PortCity \exists ExportCountry \forall DestinationCity(\text{major\_port?}(PortCity) \wedge \text{located\_in?}(PortCity, ExportCountry) \wedge \text{exports\_to?}(ExportCountry, DestinationCity) \wedge \neg\text{located\_in?}(DestinationCity, ExportCountry))$

Interpretation in Natural Language A country with a major port may ship to any city outside its borders.

13 Predicate No. `1l2m`

Well Formed Expression $\exists Reaction \forall Product \forall Impurity(\text{high\_yield?}(Reaction) \rightarrow (\neg\text{contains\_impurity?}(Product, Impurity) \wedge \text{produces?}(Reaction, Product)))$

Interpretation in Natural Language Some high-yield reaction produces products that contain no impurities.

14 Predicate No. `8h9i`

Well Formed Expression $\forall Protein \exists NLS(\neg\text{nuclear\_protein?}(Protein) \vee (\text{nls?}(NLS) \rightarrow \neg\text{contains\_nls?}(Protein, NLS)))$

Interpretation in Natural Language All proteins either aren't nuclear, or they don't have a nuclear signal.

15 Predicate No. `8a9b`

Well Formed Expression $\exists Drug \exists Target \forall Inhibitor(\text{therapeutic\_effect?}(Drug, Target) \wedge (\text{known\_inhibitor?}(Inhibitor) \rightarrow \neg\text{inhibited\_by?}(Target, Inhibitor)))$

Interpretation in Natural Language A drug works with a target that isn't blocked by any known inhibitor.

16 Predicate No. `4e5f`

Well Formed Expression $\forall Fluid1 \forall Fluid2(\neg\text{miscible?}(Fluid1, Fluid2) \rightarrow (\text{liquid?}(Fluid1) \vee \text{gas?}(Fluid2)))$

Interpretation in Natural Language If two fluids don't mix, then one is a liquid, and the other is a gas.

17 Predicate No. `7h8i`

Well Formed Expression $\exists Reaction \exists Inhibitor(\text{first\_order\_reaction?}(Reaction) \wedge \neg\text{catalyst?}(Inhibitor) \rightarrow \text{inhibited\_by?}(Reaction, Inhibitor))$

Interpretation in Natural Language Some first-order reaction is inhibited by a non-catalyst compound.

18 Predicate No. `d93a`

Well Formed Expression $\forall X \exists Y (\neg \text{man?}(X) \vee (\text{word?}(Y) \rightarrow \text{do\_honour?}(X, Y)))$

Interpretation in Natural Language Either you are not a man enough or youd honour your word.

19 Predicate No. `b8d3`

Well Formed Expression $\forall X \forall Y (\text{likes?}(X, Y) \rightarrow \exists Z (\text{knows?}(X, Z) \wedge \text{vouch?}(Z, Y)))$

Interpretation in Natural Language If someone likes another, they know someone who'd vouch for them.

20 Predicate No. `2w3x`

Well Formed Expression $\forall \mathit{Component} \forall \mathit{Condition} (\text{precision\_machined?}(\mathit{Component}) \wedge \neg \text{high\_temperature?}(\mathit{Condition}) \rightarrow \text{suitable\_for?}(\mathit{Component}, \mathit{Condition}))$

Interpretation in Natural Language All precision-machined components are suitable for non-high-temperature operating conditions.

21 Predicate No. `5c8d`

Well Formed Expression $\forall \mathit{Protein} \exists \mathit{Ligand} (\neg \text{signaling\_protein?}(\mathit{Protein}) \vee (\text{ligand?}(\mathit{Ligand}) \rightarrow \text{binds\_to?}(\mathit{Protein}, \mathit{Ligand})))$

Interpretation in Natural Language Every protein either isn't a signaling protein, or it binds to some ligand.

22 Predicate No. `4o5p`

Well Formed Expression $\forall \mathit{Material} \forall \mathit{Process} (\text{ductile?}(\mathit{Material}) \wedge \neg \text{casting\_process?}(\mathit{Process}) \rightarrow \text{suitable\_for?}(\mathit{Material}, \mathit{Process}))$

Interpretation in Natural Language All ductile materials are suitable for any non-casting manufacturing process.

23 Predicate No. `7d6f`

Well Formed Expression $\exists \mathit{City} \forall \mathit{Destination}(\text{tourist\_destination?}(\mathit{Destination}) \rightarrow (\text{coastal\_city?}(\mathit{City}) \vee \neg \text{more\_popular?}(\mathit{City}, \mathit{Destination})))$

Interpretation in Natural Language There is a city that is either a coastal city, or it's less popular than all tourist destinations.

24 Predicate No. `c4b2`

Well Formed Expression $\exists X \forall Y \forall Z(\text{teacher?}(X) \wedge \text{student\_subject?}(Y, Z) \rightarrow \text{teaches?}(X, Y, Z))$

Interpretation in Natural Language There is a teacher who teaches every student every subject.

25 Predicate No. `5f6g`

Well Formed Expression $\exists \mathit{Reaction} \forall \mathit{Product} \forall \mathit{Inhibitor}(\text{produces?}(\mathit{Reaction}, \mathit{Product}) \wedge \neg \text{inhibited\_by?}(\mathit{Product}, \mathit{Inhibitor}))$

Interpretation in Natural Language A reaction exists where all products it makes are not inhibited by any inhibitor.

26 Predicate No. `2m3n`

Well Formed Expression $\forall \mathit{Machine}(\neg \text{precision\_instrument?}(\mathit{Machine}) \vee \exists \mathit{Component}(\text{high\_strength\_alloy?}(\mathit{Component}) \wedge \text{uses?}(\mathit{Machine}, \mathit{Component})))$

Interpretation in Natural Language All machines either aren't precision instruments, or they use a high-strength alloy component.

27 Predicate No. `1b4c`

Well Formed Expression $\forall Restaurant(\text{popular?}(Restaurant) \rightarrow \exists Dish(\text{vegetarian?}(Dish) \wedge \text{serves?}(Restaurant, Dish)))$

Interpretation in Natural Language Every popular restaurant serves at least one vegetarian dish.

28 Predicate No. `8s9t`

Well Formed Expression $\forall Machine \exists Component(\neg\text{requires\_maintenance?}(Machine, Component) \vee (\text{high\_wear?}(Component) \rightarrow \text{high\_maintenance\_frequency?}(Machine)))$

Interpretation in Natural Language Every machine either has a component it rarely maintains, or it needs frequent maintenance due to some high-wear component.

29 Predicate No. `3n4o`

Well Formed Expression $\forall Component \exists AssemblyStation \exists Tool(\text{compatible?}(Tool, Component) \wedge \text{uses\_tool?}(AssemblyStation, Tool, Component))$

Interpretation in Natural Language All components are controlled by an assembly station through a compatible tool.

30 Predicate No. `0u1v`

Well Formed Expression $\forall QualityControlSystem \exists CriticalDefect \forall Sensor(\text{automated?}(QualityCont$ $(\text{critical?}(CriticalDefect) \wedge \neg\text{detects?}(Sensor, CriticalDefect)))$

Interpretation in Natural Language Automated quality control systems have blind spots for critical defects.