

CS 360 Online Quiz 5

CS 360 Online Quiz Honesty Statement

I am fully aware that once I access quiz problems I am allowed to work with my group partners only 90 minutes on them, that I may use the textbooks, lecture materials, and all other resources available via course website, but neither of the following is permitted: other books or materials, personal notes, web search tools, calculators, contacting other individuals outside my assigned group. By making a submission of my answers to the instructor I acknowledge that I followed the statement of online honesty.

You have 90 minutes for working out quiz problems, and still 15 more minutes for packaging your answers into pdf format and submitting them to the instructor via e-mail.

Solve all three problems. Each problem counts for 3 points. Extra credit problem also counts for three points.

1. Trace execution of Prolog `gcd(33, 24, X)`. Indicate each step of usage of resolution and unification.

```
gcd(U, 0, U) .  
gcd(U, V, W) :- not(V = 0), R is U mod V, gcd(V, R, W) .
```

Hint: Review slides 22-24 of Week 7 Part 3 file.

2. Take expressions $p \rightarrow q$ and $p \rightarrow r$ as hypotheses and prove the formula $p \rightarrow qr$ by deduction. You are allowed to use only the rules of inference provided below.

- (a) Any tautology may be used as a line of proof.
- (b) If E and $E \rightarrow F$ are lines of the proof, then F may be added as a line of the proof.
- (c) If E and F are lines of the proof, then EF may be added as a line of the proof.
- (d) If E and $E \equiv F$ are lines of the proof, then F may be added as a line of the proof.

A list of available tautologies:

$$\begin{aligned}(pq)^- &\equiv \bar{p} + \bar{q}, (p + q)^- \equiv \bar{p}\bar{q}, p(q + r) \equiv pq + pr, p + qr \equiv (p + q)(p + r), \\ (\bar{p})^- &\equiv p, p + p \equiv p, pp \equiv p, p + \bar{p} \equiv 1, p \rightarrow q \equiv \bar{q} \rightarrow \bar{p}, p \rightarrow q \equiv \bar{p} + q, \\ p1 &\equiv p, p0 \equiv 0, p + 1 \equiv 1, p + 0 \equiv p\end{aligned}$$

Hint: Follow the examples of figures 1-4 of week 8 file, explained in detail in week 8 lecture on Part 3 material.

3. Explain the principal components of the semantics of grammars of PLP Figures 4.5, 4.6. What are action routines? Explain their usage in the process of constructing attribute parse trees. Support your explanations with PLP Figures 4.7, 4.8.

4. (Extra credit) Design a context-free grammar for polynomials in x . Add semantic functions to produce an attribute grammar that will store the outcome of multiplication by x (as a string) in a synthesized attribute of the root of the parse tree.

Hint: Modify the attribute grammar of PLP Exercise 4.17 (Quiz 5 review problem).