SE 4367 Homework #7, BRO

Generate a BRO-adequate test set T_{BRO} for
  p_r: (a<0) $\vee$ (b=1) $\wedge$ (c>2) $\vee$ (D $\wedge$!E)

Show all the steps in generating T_{BRO}.

Draw the abstract syntax tree (AST) and label the nodes N_1 to N_m.

Explicitly list the true and false constraint sets for <u>each</u> node in the AST.

Remember to generate a test set T_{BRO} corresponding to the root node in the AST.

Grading Rubric

Setting up the AST wrong, -10 points
- common problem: doing OR before AND in this tree
- try to use their AST for the rest of the problem

Using the wrong BRO formulas for a node, -5 points
- common problem: getting ONTO product or $\{t_x\}$ wrong

Not explicitly listing the true and false constraint sets for a node, -5 points
- for N1-N5, 5 points total

Getting the wrong (true or false) constraint set for a node, -5 points each
- try to use their set for the rest of the problem

Not generating the T_{BRO} test set, -5 points
- don't care what specific values are used for a,b,c

There are legitimate alternatives for ONTO product and for $\{t_x\}$ or $\{f_x\}$ in this problem (highlighted in red in this solution).

Using one of the alternatives is legitimate. I have suggested conventions that make it easier to grade, but if you went a different (legal) way, that's acceptable.

Conventions
- order <, =, > in initial sets
- match corresponding ONTO terms until reaching the end of the shorter set; then continue matching with the last item in the shorter set
- pick the first item for a $\{t_x\}$ or $\{f_x\}$
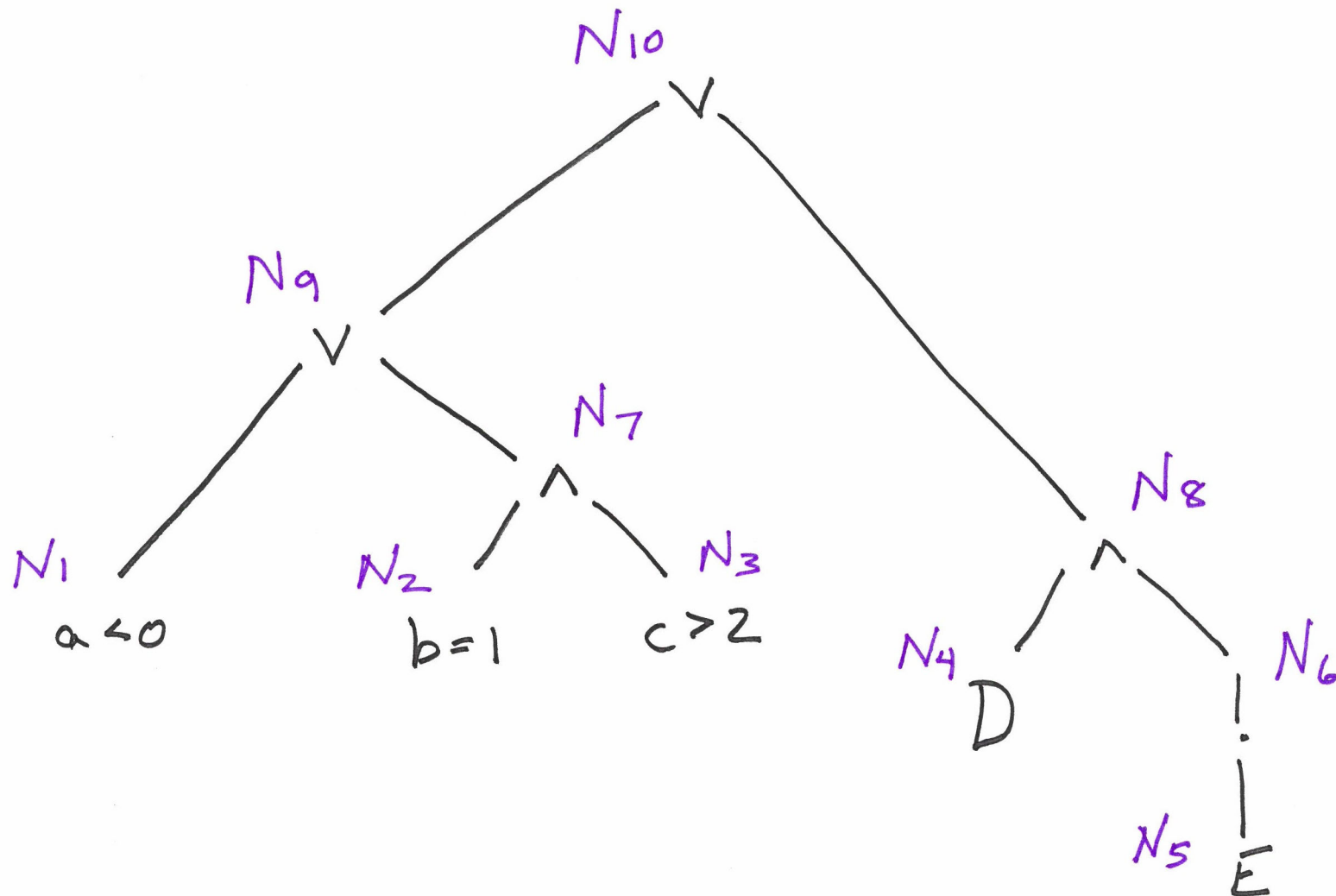
Formatting Submissions

In the file name, include:
- **class**
- **assignment identifier**
- **your name (or team's name)**
  - e.g., SE4367a01jdoe

In the file (or hardcopy) submitted, include the class, assignment, and name information at the top.

Minus 5 points per violation. Potentially 30 points off for formatting mistakes!

AST of
(a<0) ∨ [(b=1) ∧ (c>2)] ∨ (D ∧ !E)

$$S_{N1}^{t} = \{ (<) \}$$

$$S_{N2}^{t} = \{ (=) \}$$

$$S_{N3}^{t} = \{ (>) \}$$

$$S_{N4}^{t} = \{ (t) \}$$

$$S_{N5}^{t} = \{ (t) \}$$

$$S_{N6}^{t} = S_{N5}^{f} = \{ (f) \}$$

$$S_{N1}^{f} = \{ (=), (>) \}$$

$$S_{N2}^{f} = \{ (<), (>) \}$$

$$S_{N3}^{f} = \{ (<), (=) \}$$

$$S_{N4}^{f} = \{ (f) \}$$

$$S_{N5}^{f} = \{ (f) \}$$

$$S_{N6}^{f} = S_{N5}^{t} = \{ (t) \}$$

S_{N7} AND Node $f(b,c)$

$S_{N7}^{t} = S_{N2}^{t} \otimes S_{N3}^{t}$

$\quad = \{(=)\} \otimes \{(>)\}$

$\quad = \{(=,>)\}$

$S_{N7}^{f} = \left(S_{N2}^{F} \times \{t_{N3}\} \right) \cup \left(\{t_{N2}\} \times S_{N3}^{f} \right)$

$\quad = \left(\{(<),(>)\} \times \{(>)\} \right) \cup \left(\{(=)\} \times \{(<),(=)\} \right)$

$\quad = \left(\{(<,>),(>,>)\} \right) \cup \left(\{(=,<),(=,=)\} \right)$

$\quad = \{(<,>),(>,>),(=,<),(=,=)\}$

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S_{N8} AND Node $f(D, E)$

$$S_{N8}^t = S_{N4}^t \otimes S_{N6}^t$$

$$= \{(t)\} \otimes \{(f)\}$$

$$= \{(t, f)\}$$

$$S_{N8}^f = \left(S_{N4}^f \times \{t_{N6}\}\right) \cup \left(\{t_{N4}\} \times S_{N6}^f\right)$$

$$= \left(\{(f)\} \times \{(f)\}\right) \cup \left(\{(t)\} \times \{(t)\}\right)$$

$$= \{(f, f), (t, t)\}$$

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S_{N9} OR Node $F(a,b,c)$

$$S_{N9}^{t} = \left(S_{N1}^{t} \times \{f_{N7}\} \right) \cup \left(\{f_{N1}\} \times S_{N7}^{t} \right)$$

$$= \left(\{(<)\} \times \{(<,>)\} \right) \cup \left(\{(=)\} \times \{(=,>)\} \right)$$

$$= \left(\{(<,<,>)\} \right) \cup \left(\{(=,=,>)\} \right)$$

$$= \{ (<,<,>), (=,=,>) \}$$

$$S_{N9}^{f} = S_{N1}^{f} \otimes S_{N7}^{f}$$

$$= \{ (=),(>) \} \otimes \{ (<,>),(>,>),(=,<),(=,=) \}$$

$$= \{ (=,<,>),(>,>,>),(>,=,<),(>,=,=) \}$$

S_{N10} OR Node $F(a, b, c, D, E)$

$$S_{N10}^{t} = \left(S_{N9}^{t} \times \{f_{N8}\}\right) \cup \left(\{f_{N9}\} \times S_{N8}^{t}\right)$$

$$= \left(\{(<,<,>),(=,=,>)\} \times \{(F,F)\} \right. \cup$$

$$\left. (\{(=,<,>)\} \times \{(t,F)\}\right.$$

$$= \{(<,<,>,F,F),(=,=,>,F,F),(=,<,>,t,F)\}$$

$$S_{N10}^{f} = S_{N9}^{f} \otimes S_{N8}^{f}$$

$$= \{(=,<,>),(>,>,>),(>,=,<),(>,=,=)\} \otimes$$

$$\{(f,F),(t,t)\}$$

$$= \{(=,<,>,f,F),(>,>,>,t,t),(>,=,<,t,t),$$

$$(>,=,=,t,t)\}$$

Many possible correct answers that satisfy the constraints.

$$t_1 = (-1, 0, 3, False, False)$$

$$t_2 = (0, 1, 3, False, False)$$

$$t_3 = (0, 0, 3, true, false)$$

$$t_4 = (0, 0, 3, False, false)$$

$$t_5 = (1, 2, 3, true, true)$$

$$t_6 = (1, 1, 1, true, true)$$

$$t_7 = (1, 1, 2, true, true)$$

TRUE

FALSE