

Activity: Values of Expressions

A. Why?

Expressions are part of our programming language, so their values are part of the semantics of our programming language and specification predicates.

B. Outcomes

By the end of the activity you should

- Understand the different meanings of “is” in English sentences like “ s *is* the expression $2*x$ ” and “if $\sigma(x)=4$, s *is* 8.”
- Be able to translate between English and mathematical notation for the values of expressions.
- Have an intuitive notion of what the value of an expression is in our language.

C. Questions

As you did last week, form groups of 5, assign roles, and answer the following questions. Email the results to f09cs536@gmail.com.

Here’s an example of a state, an expression, and the value of the expression in that state: let $\sigma(x)=1$, $\sigma(y)=2$, and $\sigma(b) = \beta$ where $\beta(0) = 5$, and let $s_1 \equiv x+y$, then $\sigma(s_1) = \sigma(x+y) = \sigma(x)+\sigma(y) = 1+2 = 3$. (I.e., “In state σ , the value of s_1 equals the value (in σ) of the expression $x+y$, which equals the value (in σ) of x plus the value (in σ) of y , which equals 1 plus 2, which equals 3.”)

1. Take the two statements “ s_1 is the expression $x+y$ ” and “in σ , s_1 is 3.” Which use of “is” means “is the name of”? Which use of “is” means “has a value equal to”?

First “is” means “is the name of”. Second “is” means “has a value equal to”.

In $s_1 \equiv x+y$ the “ \equiv ” means “is the name of” or “is syntactically equal to” or “stands for the text”.

2. Translate into (more-mathematical) notation the English “In σ , the value of the expression $b[x-1]$ equals 5.” (Don’t worry about showing intermediate steps.)

$\sigma(b[x-1]) = 5$

3. Translate into notation the English “The value of the expression $x+4$ in σ is (the value of x in σ) plus 4.”

$\sigma(x+4) = \sigma(x)+4$ $\sigma(x)$ plus 4

$\sigma(x \text{ plus } 4)$????

4. (If you have extra time, try this problem: Translate into notation the following English, which extends Problem 2.

In σ , the value of $b[x-1]$

equals the function that b stands for (in σ) applied to the value (in σ) of the expression $x-1$

equals β applied to (the value in σ of x) minus (the value in σ of 1)

equals β applied to 1-1

equals β applied to 0

equals 5

)

$$\sigma(b[x-1]) = \sigma(b)(\sigma(x-1))$$

$$= \beta(\sigma(x) - \sigma(1))$$

$$= \beta(1-1)$$

$$= \beta(0)$$

$$= 5$$