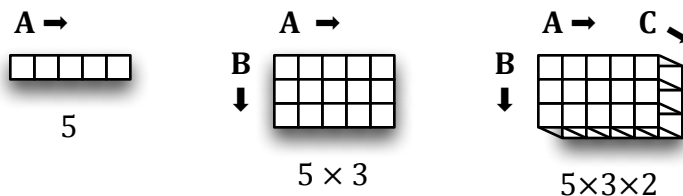


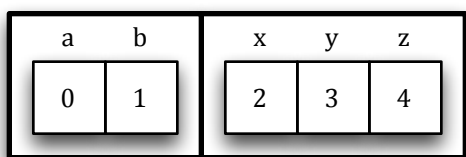
FAST System Homework

WU CS 465—Fritz Ruehr—Spring 2019

Some quick notes on how to draw and count in multi-dimensional grids: we will use the conventions illustrated in the following diagrams—note especially that “first dimension” is drawn from left-to-right, even in the higher-dimensional cases. A standard for ordering the locations in sums and products is illustrated in the second set of diagrams.



2 + 3 or "ab" + "xyz"



$La = 0$

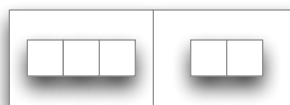
$Ry = 3$

4 × 3 or "abcd" × "xyz"

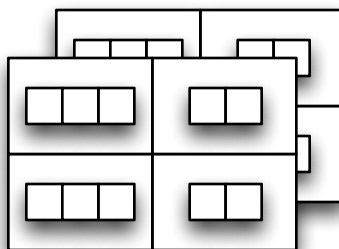
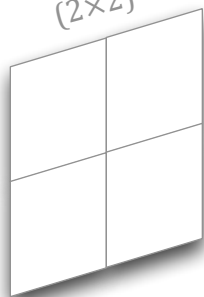
	a	b	c	d
x	0	1	2	3
y	4	5	6	7
z	8	9	10	11

$cy = 6$

(3+2)



(2×2)



$(3+2) \times (2 \times 2)$

We can give numeric/symbolic codes for values informally as follows:

- for numeric or alphabetic (constant) types, by writing a numeral or symbol for the value (use a bullet • for the value of the binary type 1);
- for sums, by using a preceding **L** or **R** tag;
- for products, by simply writing the codes one after another; and
- for functions, by writing out the sequence of results in the natural order of the arguments.

(Feel free to use punctuation, etc., if you feel it is natural and helpful.)

0. Recall that, according to the study of semiotics, a sign may have iconic, indexical, or symbolic aspects, where icons have a resemblance of form (to their meanings), indices have a causal connection (like smoke & fire, or a thermometer reading), and symbols are arbitrary-but-conventional (like the shapes of letters).

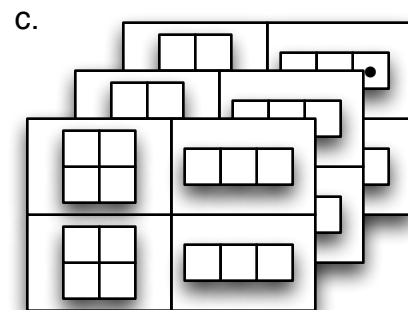
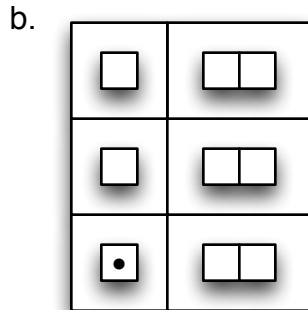
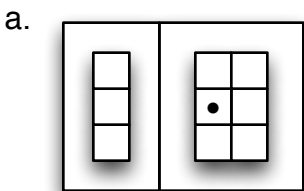
Give examples (not from here or in class!) of signs which are (primarily) each of icons, indices, and symbols. See if you can find an example that has two or more of these aspects, perhaps to varying degrees.

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1. For each of the following FAST type expressions, draw a corresponding grid; mark some location in the grid and provide a numbered location for it. (There may be some variation in answers here: part of the goal is to see what students' intuitions are.)

- $2 + (2 \times 3)$
- $3 \times (1 + 3)$
- $2 \times (1 + (3 \times 2))$

2. For each of the following grids, provide a corresponding FAST type, as a numeric expression, and provide a number (in standard order) for the marked location.



3. People at the state fair play for carnival prizes on the “midway”: knock down some bottles with a baseball or pull the right fish out of the pond and you can choose from among the following: a stuffed animal (duck, beaver, or bearcat), a t-shirt (small, medium, large or extra-large; and red, green or blue); or a plastic water bottle (no sizes, just red, green or blue). Give a

description of the possible choices as two different FAST types, one numeric and one using symbolic alphabets (i.e., strings such as “RGB”). How many choices of prize are there in total? Give English descriptions and reasonable symbolic codes for choices #7 and #16.

4. After all those games & prizes, you might be hungry—here’s what the menu at the local pizza shop looks like: you can get a thin or a thick crust; choose mozzarella, soy, or no cheese; and choose to have any of these toppings: pepperoni, beef, mushrooms, olives, and green peppers. Model this as a FAST type using symbolic codes; model the topping choices using a function from toppings to “Booleans” (use the type **2** with values 0 or 1). Give English descriptions, symbolic codes, and numeric locations for two pizzas (one should be your favorite). How many possible pizza choices are there?

How will the model change if we split the toppings into meats and veggies, keeping the same actual set (and even the order) of possible toppings, but now using a sum type for the whole. How does this change the function from toppings to Booleans? (The total number of choices should stay the same.)

How could we change the model to accommodate a new policy: you may now order normal or “extra” (or none at all) for any of your toppings. How many pizza choices are there now?

Say we add some variations on calzones to the menu, as a top-level sum/choice between pizzas (first) and calzones (second). Will the “location number” / numeric code of your favorite pizza change? What about the symbolic code?