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Computational Modeling Homework #2

1. Notice that some non-Ken instance units appear to be more active than others (based on the final unit activations). Can you explain why this is the case? That is, explain why it is the case that some of these non-Ken units differ in the degree to which they are active. [A good answer will be able to explain in detail what is contributing to the *differences* in activation. Your answer must also extend beyond the provided example answer]. **(10 points)**

The "Ken" example in the Training Sets corresponds to the "Ken" unit and "Ken" properties. In this example, Pete, Fred, Earl, Rick, Neal, and Nick all appear to be somewhat active; however, both Neal and Nick are more active than the others. These other instance units can share some of Ken's specific properties, and activation of these properties causes the other instance units to also become activated. Neal and Nick share properties including having a high school education, being a Shark, and being single; so, Neal and Nick have the same activation of 0.308961. Pete, who has an activation of 0.06514, shares that he has a high school education, is single, and is in his 20s, but his activation is lower because these shared properties are less activated compared to Neal and Nick's shared properties. Non-Ken units differ in the degree to which they are active because certain properties are more activated than others, causing certain instance units to be more or less activated than others, and some non-Ken units share more properties with Ken compared to others.

2. Note that there is some activation of the Pusher and Bookie occupation units (in addition, of course, to activation of the Burglar unit, which specifies Ken's occupation). Why do these other occupations show some degree of activation? (It is useful to contrast this case with the one in which we selected just "Ken-in" from the Training Set.) **(10 points)**

In this "Sharks 20s" example, the Pusher (0.115515) and Bookie (0.01489) occupation units have some activation. One main difference between this example and the "Ken" example is that the"20s" unit is much more activated which could be causing the instance units, "Pete" and "Fred," to be much more active as well. Pete is a bookie and Fred is a Pusher, so that could be, in turn, activating the occupation units.

3. The model is doing something stunning here. Specifically, it seems able to deduce Lance's occupation (despite the fact that we've severed that connection—you can double-check that we have, in fact, severed that connection by right-clicking on either Lance or Burglar and noting that there is no connection, either positive or negative, between these two units). Explain how the model was able to do this? In your response, please also discuss why the Divorced unit becomes activated along with the Married unit. **(10 points)**

The instance units activated other than Lance consist of Alan, George, Jim, and John since they all share properties that Lance has. Two of these men are divorced while the other two are married, and Lance is married which explains why the activation for married is higher while the divorced unit still becomes activated albeit to a lesser extent. All four of these men are also Jets who have a junior high education and are mostly in their 20s and are all burglars. Since these men are so similar or "typical" compared to Lance, the model can assume that Lance follows their trend and is also a burglar.

4. This question requires that you think carefully and critically about whether, in fact, windows and drapes form a subschema, as Rumelhart and colleagues argued. It is critical that you provide evidence for your stance by actually running the simulation and assessing the "goodness" values. You are **not** permitted to use Fig. 13 as evidence for your stance. **(10 points)**

After turning on the "drapes" and "windows" units and running the simulation, I assessed the "goodness" value in the context of the training set, "office (prototype)." Then, I turned off one while keeping the other on and vice versa and finally turned off both, looking at the goodness values of each scenario. I found that the "goodness" values were highest when the window and drapes both off or both on and lowest when one was off and the other on. Thus, window and drapes "go together" and form a subschema.

Training Set:	"Goodness" Value
Office (prototype) both on	19.623804
Office (prototype) w on; d off	19.352615
Office (prototype) w off; d on	19.109230
Office (prototype) both off	19.784773

5. Identify the ways in which the combined final pattern differs from each of the single feature patterns and try to explain those differences. Does the pattern produced by one of the features predominate, or is the mix fairly even, and why? How does the goodness value of the combined pattern compare with those of the single-feature patterns, and why? You will find it useful to examine the pattern of weights among units (see the actual network or Figure 5 in the Rumelhart et al. chapter) in explaining why the network behaves the way that it does. **(10 points)**

I chose fire-place and toilet features, turned the features on, and looked at the "empty" example. Below are the "goodness" values for each.

Training Set:	Goodness:
Empty (both on)	12.606302
Empty (f-p on, t off)	17.316408
Empty (f-p off, t on)	3.844952

The final activation for fire-place is 0.9, and the final activation for toilet is 0.896376.

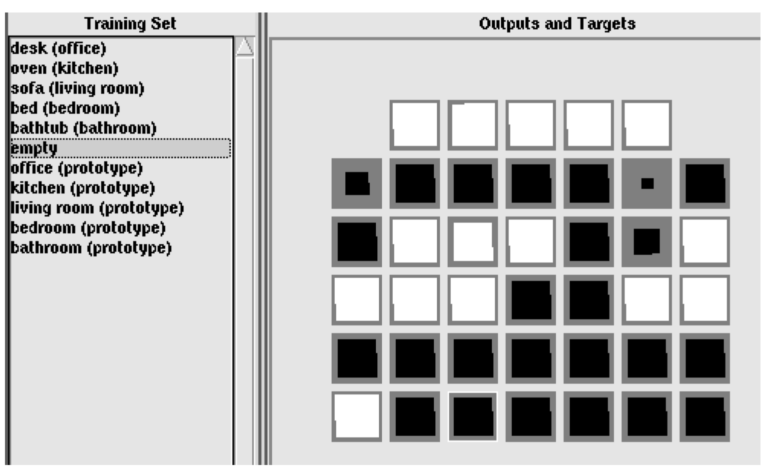

Figure 1: fire-place turned on; toilet turned off

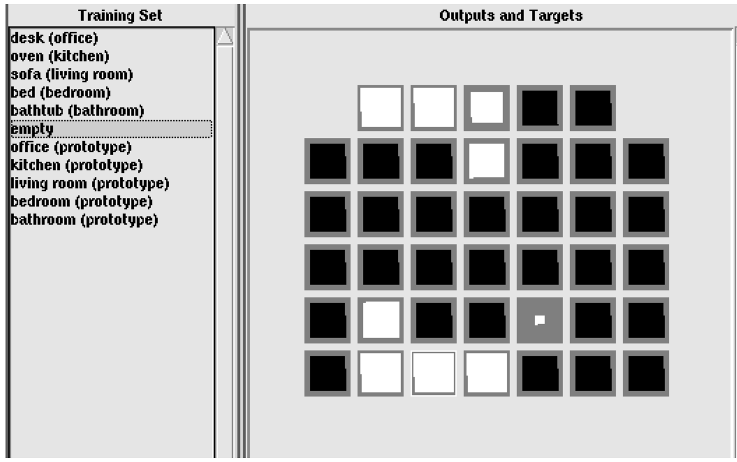

Figure 2: fire-place turned off; toilet turned on

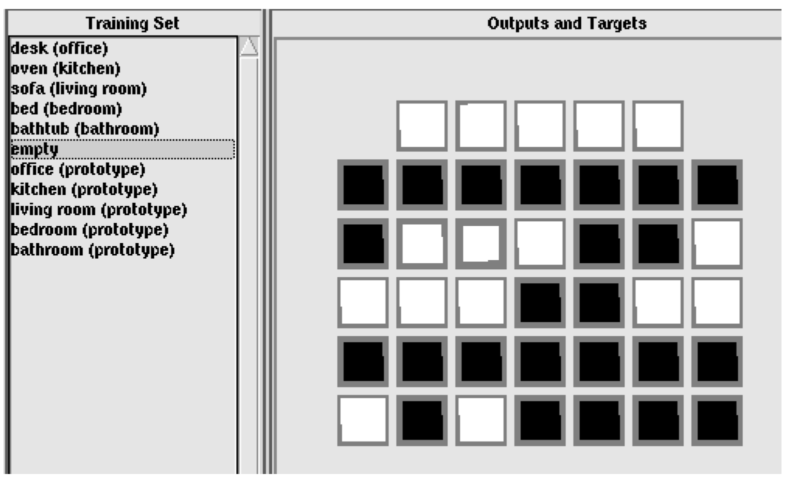

Figure 3: Fire-place and Toilet turned on

The combined final pattern in Figure 3 differs from the "fire-place turned off; toilet turned on" pattern in Figure 2 in that the latter has features corresponding to a typical bathroom turned on such as bathtub and scale, but Figure 3 has those turned off. Figure 1 is more similar to Figure 3 in that many of the features corresponding to a typical living room are turned on, but some of the features in Figure 3 have lower activations such as bookshelf and carpet since they would not appear in a bathroom. It seems as though the pattern produced by having the fire-place on and toilet off is predominant compared to the reverse since features that appear in a living room could also appear in a bathroom such as a floor-lamp and carpet, but features that appear in a bathroom such as a bathtub are things you would be less likely to find in a living room.

The goodness value of the combined pattern falls between the goodness values of the single-feature patterns but leans more towards the goodness value when the fire-place is on and the toilet off. We can attribute this skew to the weights of each unit as the "toilet" unit is negatively connected to many of the other units and not highly positively connected to many units, but the "fire-place" unit is positively connected to more units.