

## Solutions for selected exercises of Chapter 3

1. **Exercise on state prior:** Visualize the `statePrior`.

```
Infer(statePrior)
```

2. **Exercise on threshold prior:** Visualize the `thetaPrior`.

```
Infer(thetaPrior)
```

3. **Exercises on literal listener:** Check  $L_0$ 's predictions for various price cutoffs.

```
literalListener("expensive", 20)
literalListener("expensive", 19)
literalListener("expensive", 2)
```

This is just conditionalizing the state prior on the observation that the price is higher than the supplied threshold.

3. **Exercises on full model for fictitious book prices:**

- I. What happens when you make the "expensive" utterance more costly? Why?

With cost for 'expensive' set to 1 the most likely price interpretation is 22 (when alpha is 2). This changes when we set the cost of 'expensive' to 10. Now, the most likely price interpretation is 30 (the highest possible price state in the model). This is so because the higher the cost of uttering 'expensive', the less likely the speaker is to prefer it over remaining silent (the null utterance) UNLESS investing the cost into saying expensive is really informative. So, from the pragmatic listener's point of view, hearing 'expensive' (with costs = 10) is only rational for a speaker who knows that the price is really, really high AND who also has a threshold for 'expensive' that would then make the utterance of 'expensive' informative enough to trump the immense costs.

Similar considerations apply to the pragmatic listener's inferences about the threshold.

- II. Try altering the `statePrior` and see what happens to  $L_1$ 's inference.

Changes to the prior are clearly reflected in the posteriors over prices (unless costs or alpha are set to extreme values). These effects should, for the most part, be quite intuitive. Play around with stuff like the below and try to see if the output makes sense to you.

```
var book = {
  "prices": [2, 6, 10, 14, 18, 22, 26, 30],
  "probabilities": [1, 2, 30, 4, 4, 3, 2, 1]
};
```

#### 4. Exercises on full model with empirically measured priors:

- I. Visualize the various state priors.

```
viz.density(Infer( statePrior_lookup("coffee maker") ))
viz.density(Infer( statePrior_lookup("headphones") ))
viz.density(Infer( statePrior_lookup("laptop") ))
viz.density(Infer( statePrior_lookup("sweater") ))
viz.density(Infer( statePrior_lookup("watch") ))
```

- II. Check  $L_1$ 's behavior for coffee makers, headphones and laptops.

Here's the code for 'coffee makers' only:

```
var expensiveCoffeeMaker= pragmaticListener("expensive",
"coffee maker");
print("the listener's posterior over coffee maker
prices:")
viz.density(marginalize(expensiveCoffeeMaker, "price"));
print("the listener's posterior over coffee maker price
thresholds:")
viz.density(marginalize(expensiveCoffeeMaker, "theta"));
```

- III. Add and  $S_2$  layer to the model and check its predictions.

```
var speaker_2 = function(state, item) {
  var thetaPrior = thetaPrior_lookup(item);
  return Infer({method: "enumerate"}, function() {
    var utterance = utterancePrior();
    var theta = thetaPrior();
    factor( alpha * (pragmaticListener(utterance,
item).score({price: state, theta: theta})
- cost[utterance]));
    return utterance;
  });
}
```

```
speaker_2(122, "coffee maker")  
speaker_2(222, "coffee maker")
```