

CATX: contextual bandits with continuous action using trees with smoothing in JAX

A JAX implementation of the "Efficient Contextual Bandits with Continuous Actions" paper

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Tree

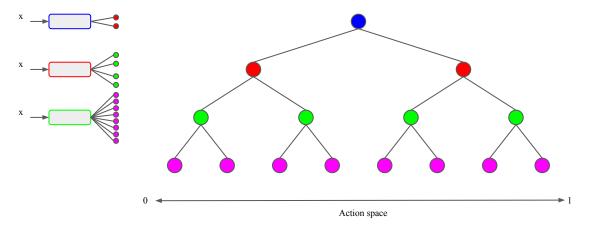


Tree

This example uses a tree of depth 3

At each depth there is neural network (depth 0: blue, depth 1: red, and depth 2: green)

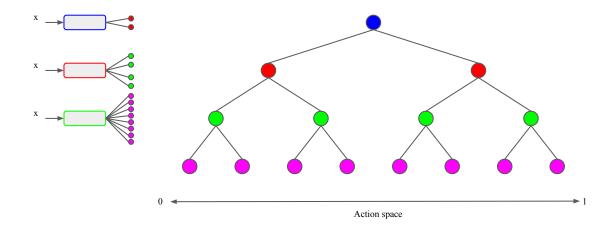
Each neural network output layer dimension is 2^(depth+1)

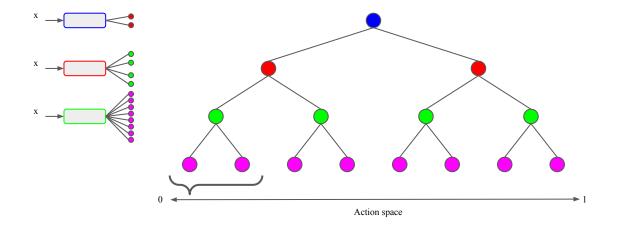


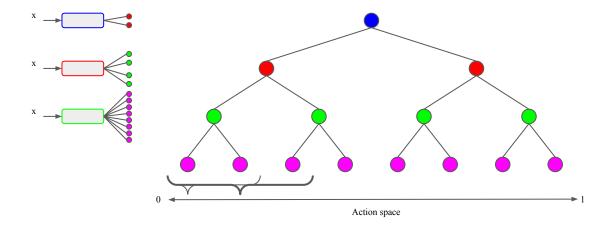
```
class Tree(hk.Module):
    def __init__(
        self,
        network_builder: NetworkBuilder,
        tree_params: TreeParameters,
        name: Optional[str] = None,
):
```

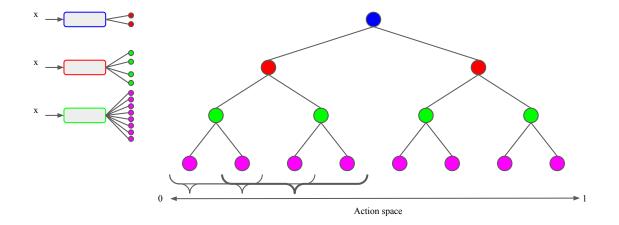


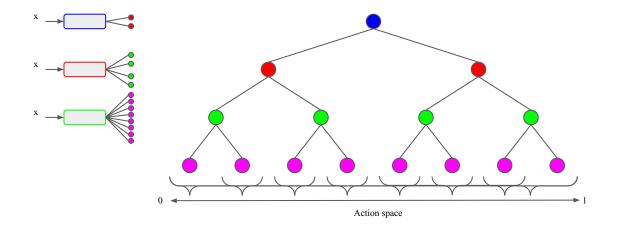
action spaces



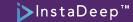


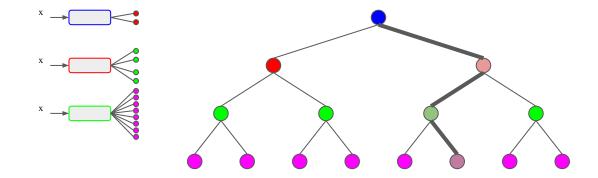


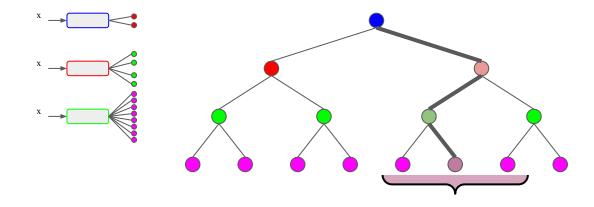


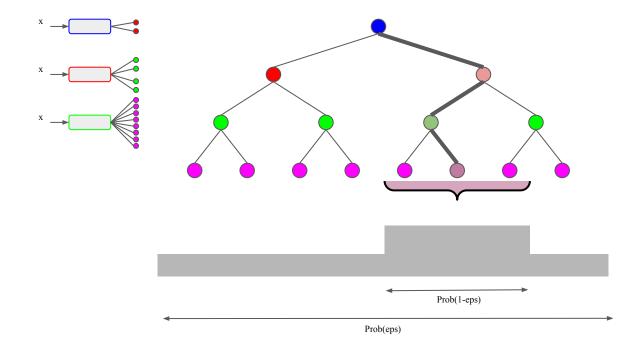


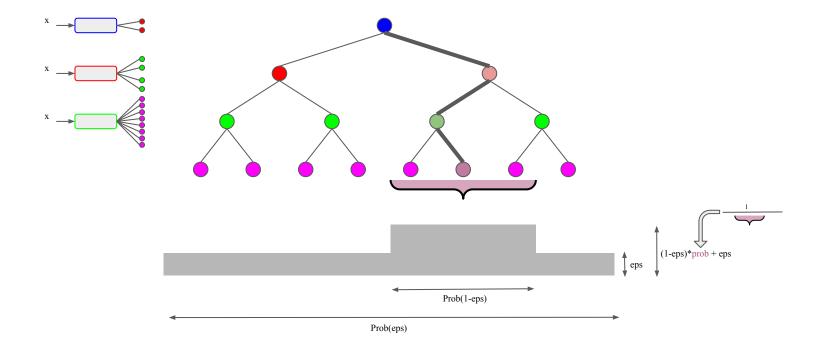
Action query

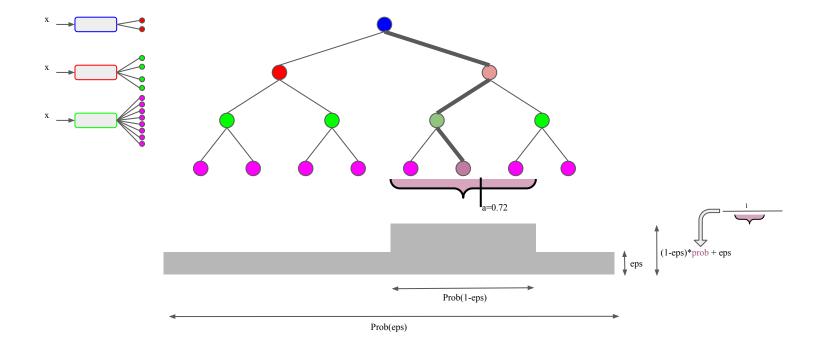






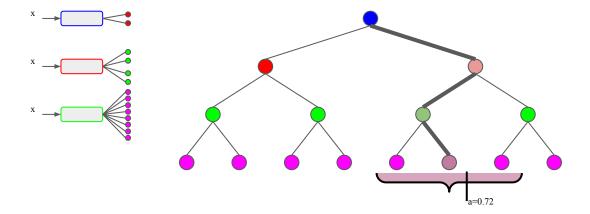




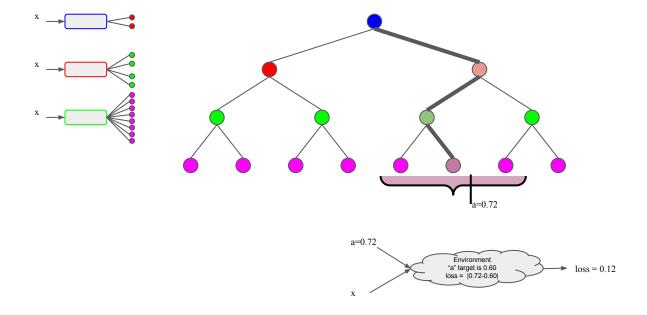




apply action in the environment and receive cost feedback

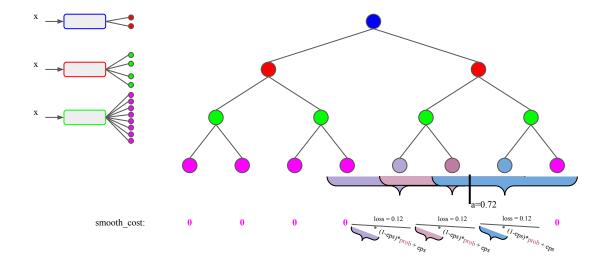


apply action in the environment and receive cost feedback

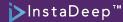


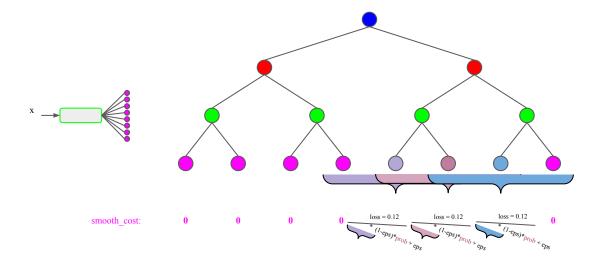
smooth the cost across the discretized actions that could have generated the applied action

@functools.partial(jax.jit, static_argnames=("self",))
def _compute_smooth_costs(
 self, costs: JaxCosts, actions: JaxActions, probabilities: JaxProbabilities)
) -> JaxCosts:



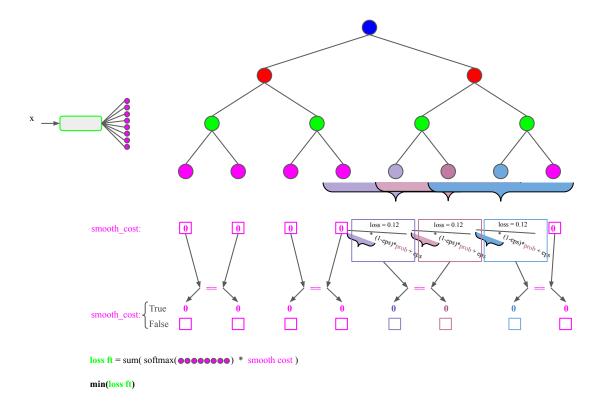
Update neural network weights





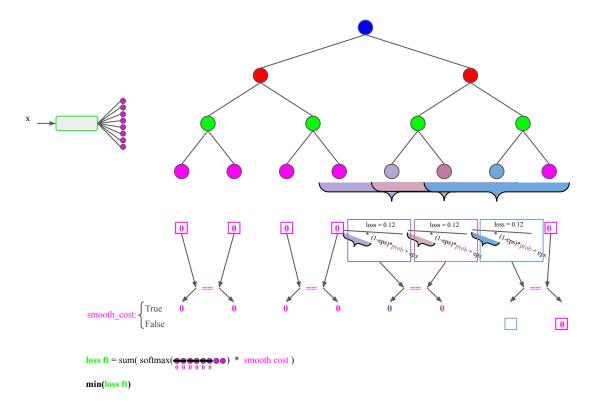
```
def learn(
    self,
    obs: Observations,
    actions: Actions,
    probabilities: Probabilities,
    costs: Costs,
```

Update: x Only update nodes whose pair childs have different cost.



```
def learn(
    self,
    obs: Observations,
    actions: Actions,
    probabilities: Probabilities,
    costs: Costs,
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Only update nodes whose pair childs have different cost. In this example:

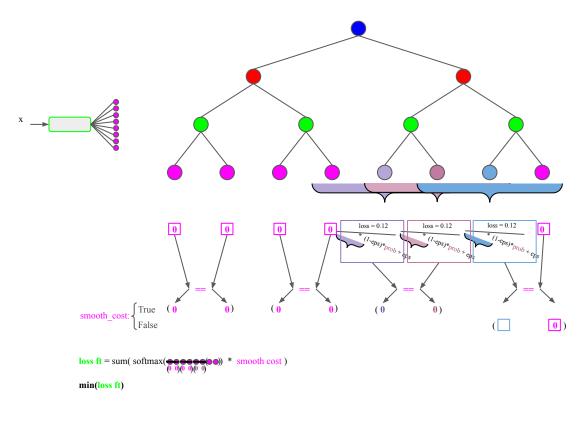


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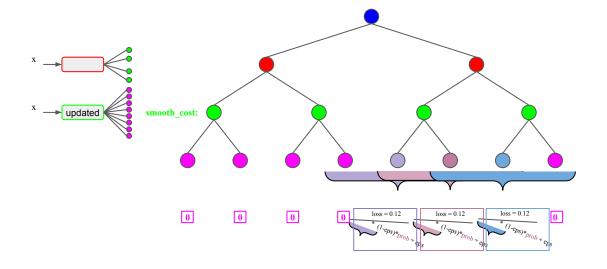
Only update nodes whose pair childs have different cost.

In this example:

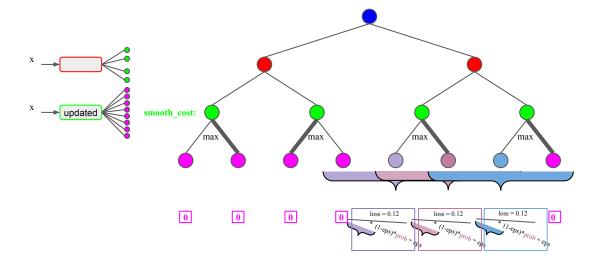
Note: the softmax is performed pairwise

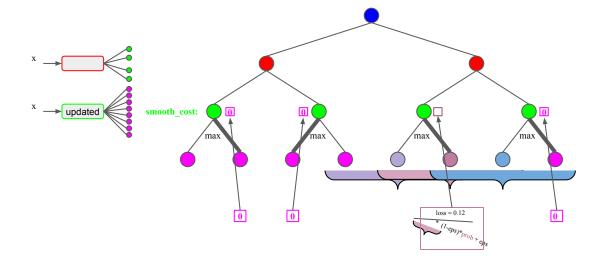


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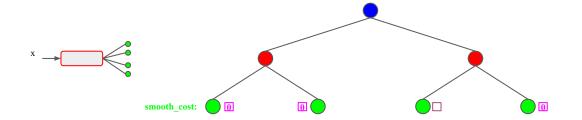


```
loss ft = sum( softmax(\bullet \bullet) \bullet \bullet) * smooth cost )
min(loss ft)
```

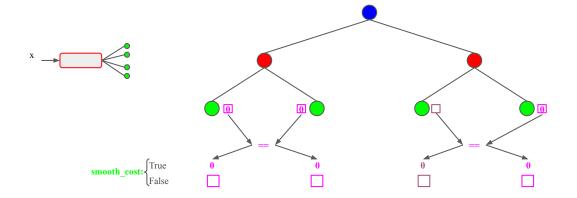




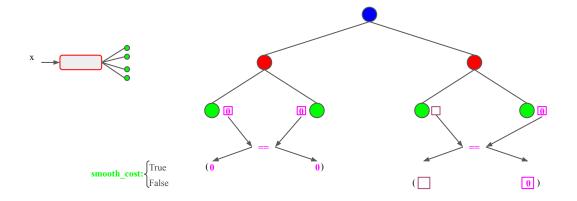
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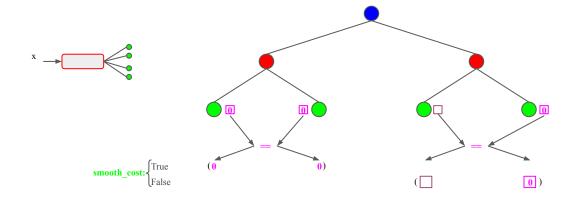
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loss ft = sum( softmax(( \bullet \bullet ) ( \bullet \bullet ) ) * smooth cost )
min(loss ft)
```



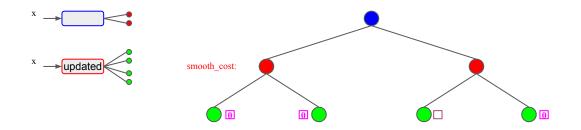
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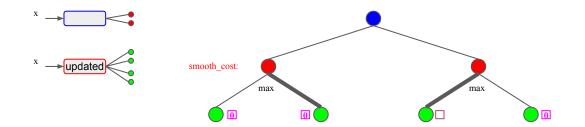
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min(loss ft)
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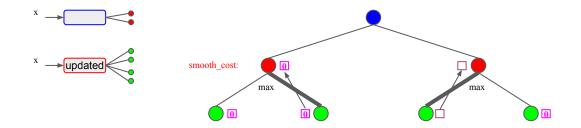
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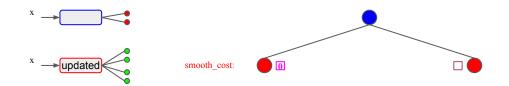
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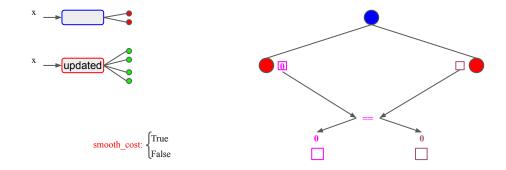
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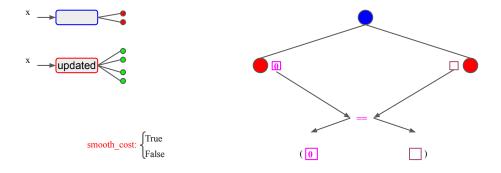
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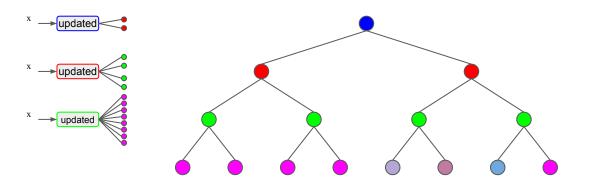


```
loss ft = sum( softmax(\bullet \bullet) * smooth cost )
min(loss ft)
```



```
loss ft = sum( softmax(( ) * smooth cost )
min(loss ft)
```

Update:



```
def learn(
    self,
    obs: Observations,
    actions: Actions,
    probabilities: Probabilities,
    costs: Costs,
```