ADVANCED DEEP LEARNING WITH KERAS IN PYTHON

Category embeddings

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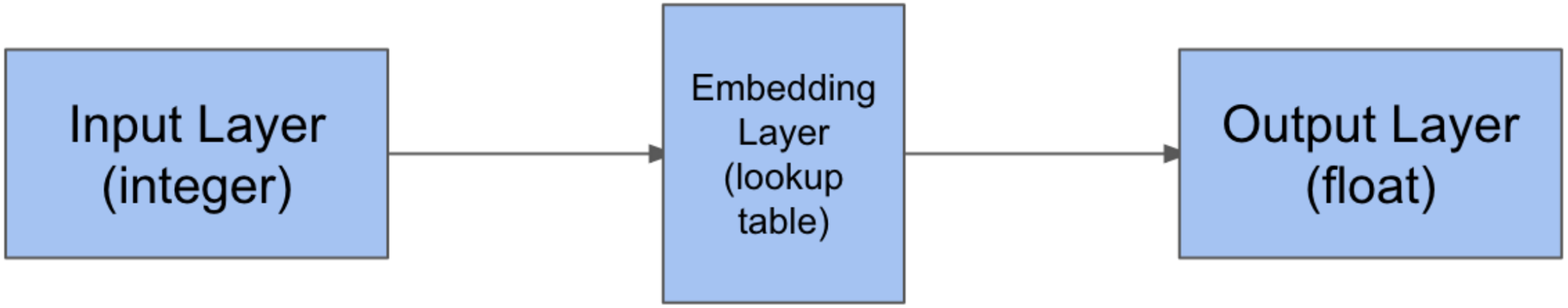
Data Scientist

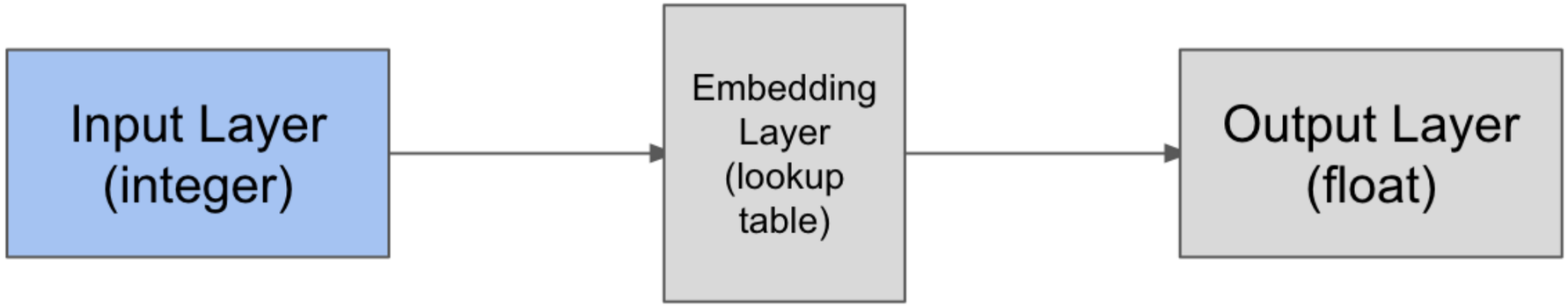
Category embeddings

- Input: integers
- Output: floats
- Note: Increased dimensionality: output layer flattens back to 2D



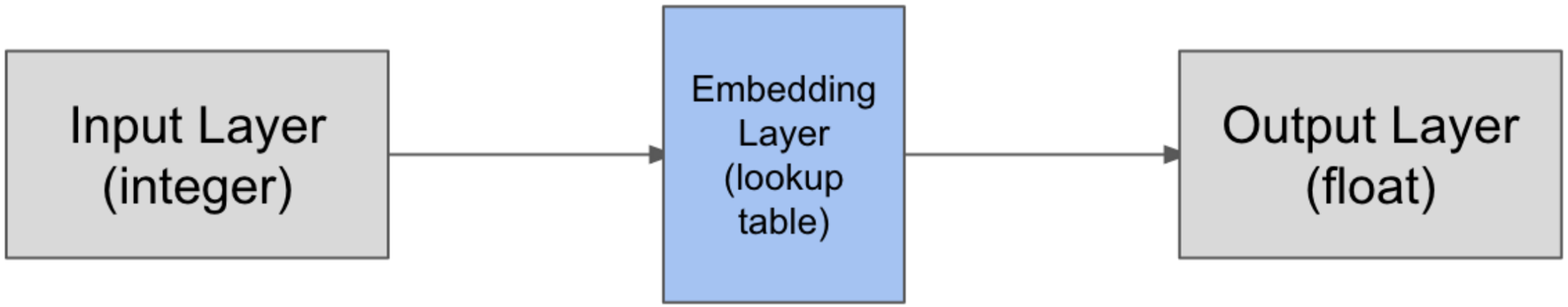
Inputs

```
input_tensor = Input(shape=(1,))
```



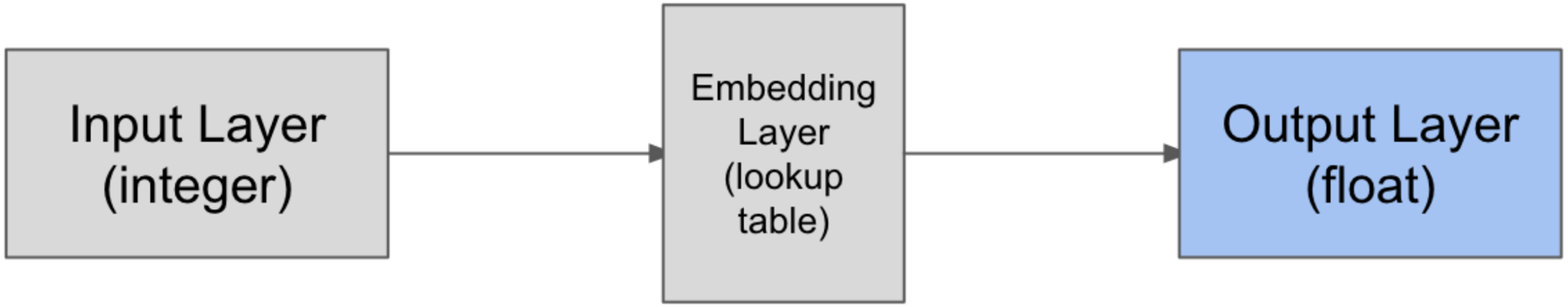
Embedding Layer

```
from keras.layers import Embedding
input_tensor = Input(shape=(1,))
n_teams = 10887
embed_layer = Embedding(input_dim=n_teams,
                        input_length=1,
                        output_dim=1,
                        name='Team-Strength-Lookup')
embed_tensor = embed_layer(input_tensor)
```



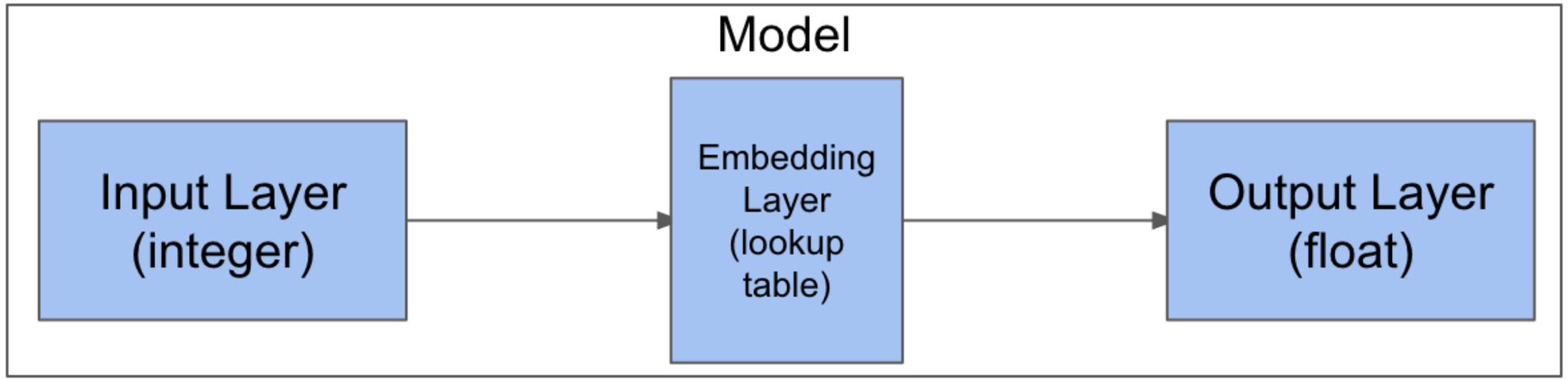
Flattening

```
from keras.layers import Flatten
flatten_tensor = Flatten()(embed_tensor)
```



Put it all together

```
input_tensor = Input(shape=(1,))
n_teams =  10887
embed_layer = Embedding(input_dim=n_teams,
                        input_length=1,
                        output_dim=1,
                        name='Team-Strength-Lookup')
embed_tensor = embed_layer(input_tensor)
flatten_tensor = Flatten()(embed_tensor)
model = Model(input_tensor, flatten_tensor)
```



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Shared layers

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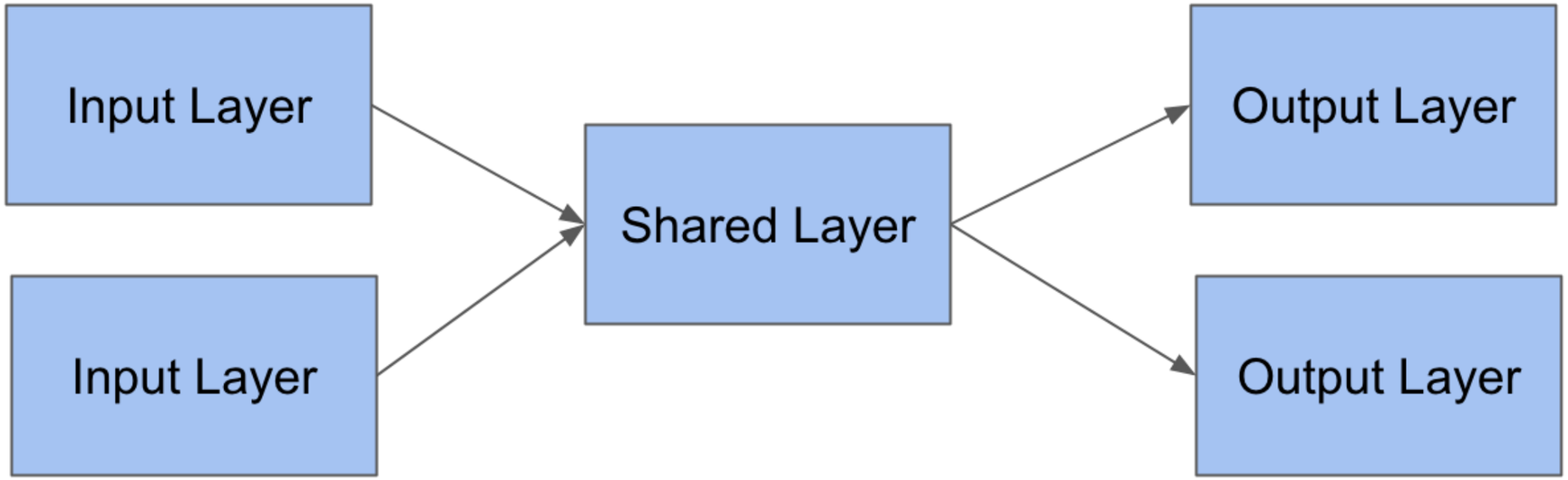
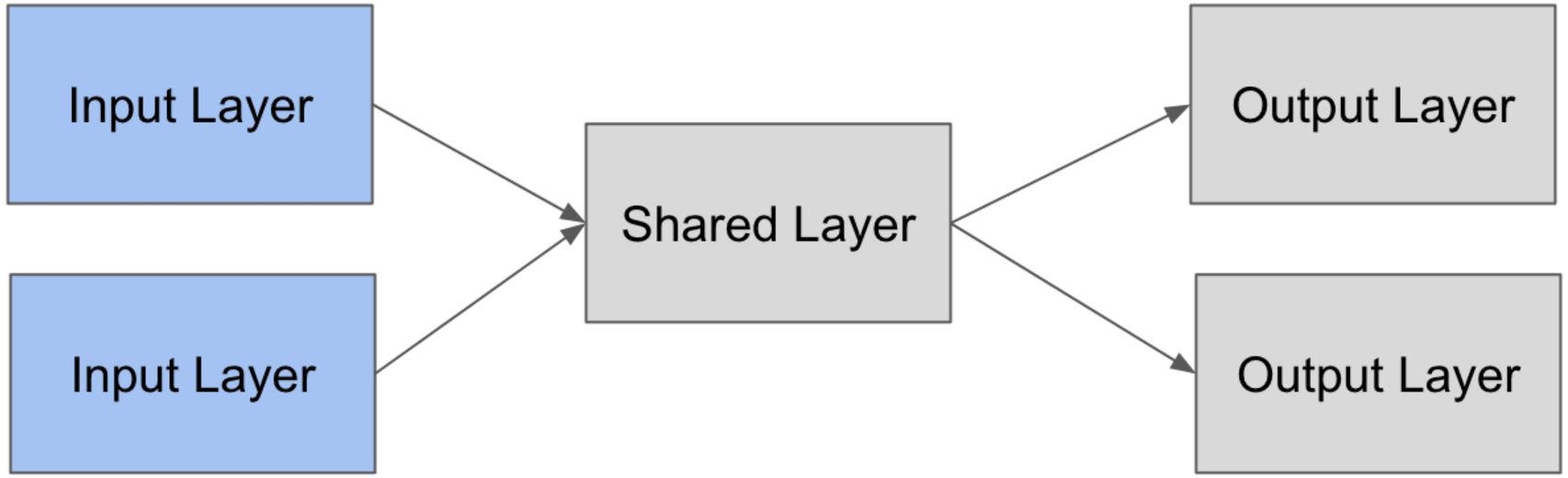
Shared layers

- Require the functional API
- Very flexible



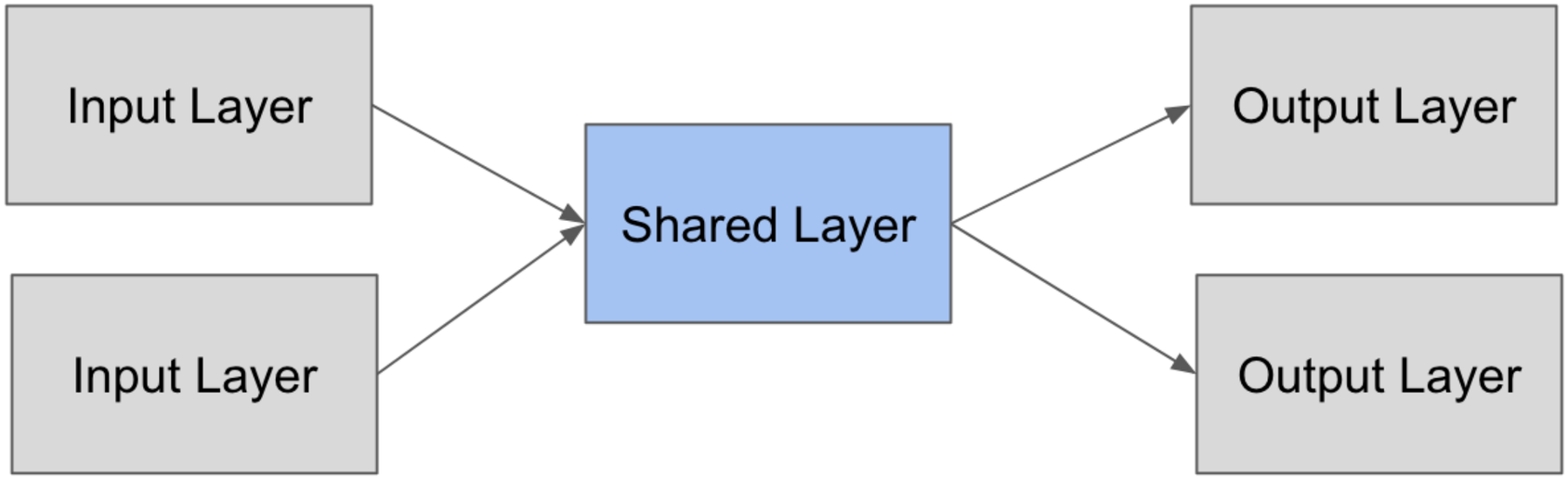
Shared layers

```
input_tensor_1 = Input((1,))
input_tensor_2 = Input((1,))
```



Shared layers

```
shared_layer = Dense(1)
output_tensor_1 = shared_layer(input_tensor_1)
output_tensor_2 = shared_layer(input_tensor_2)
```

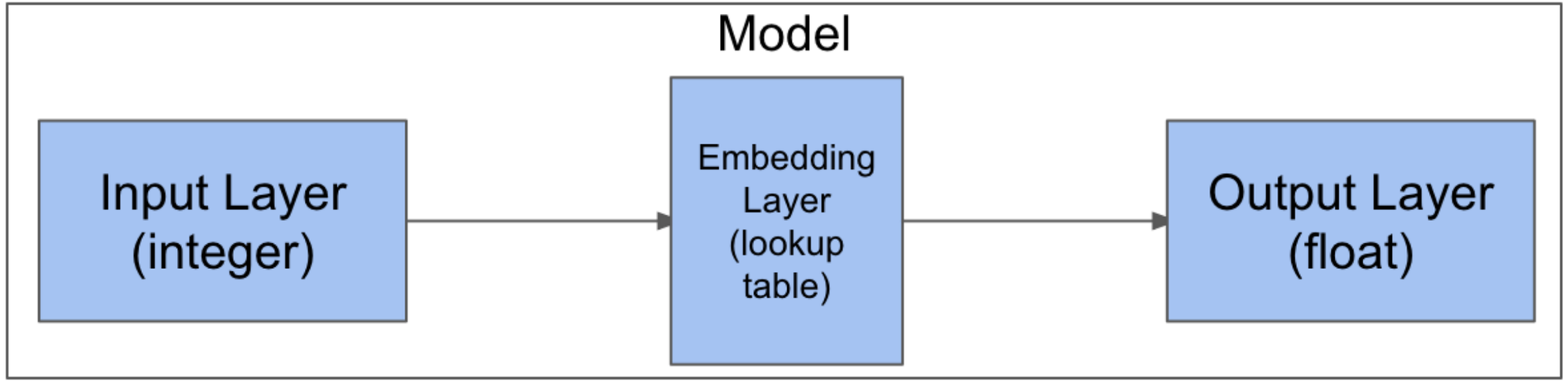


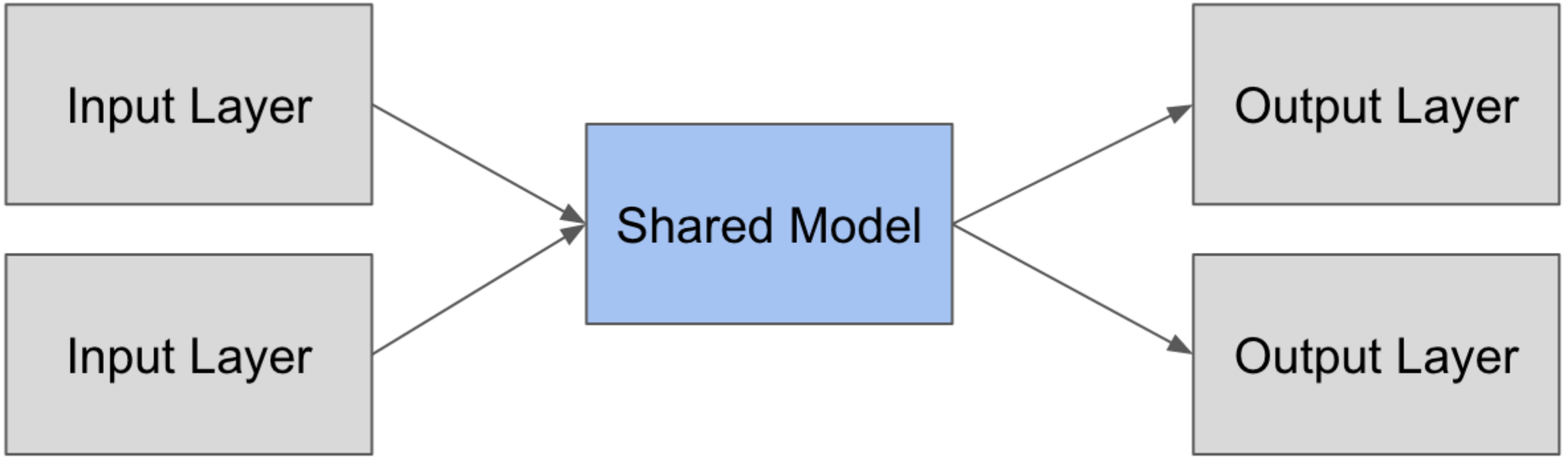
Sharing multiple layers as a model

```
input_tensor = Input(shape=(1,))
n_teams = 10887
embed_layer = Embedding(input_dim=n_teams,
                        input_length=1,
                        output_dim=1,
                        name='Team-Strength-Lookup')
embed_tensor = embed_layer(input_tensor)
flatten_tensor = Flatten()(embed_tensor)
model = Model(input_tensor, flatten_tensor)
```

```
input_tensor_1 = Input((1,))
input_tensor_2 = Input((1,))
output_tensor_1 = model(input_tensor_1)
output_tensor_2 = model(input_tensor_2)
```

Sharing multiple layers as a model





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Merge layers

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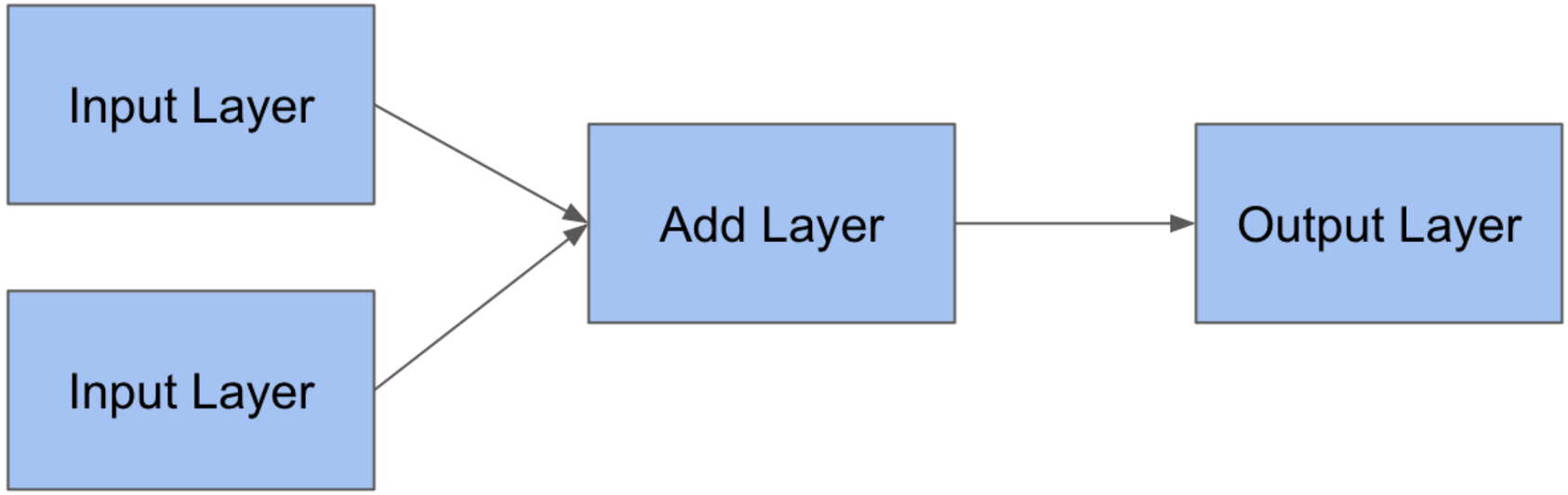
Merge layers

- Add
- Subtract
- Multiply
- Concatenate

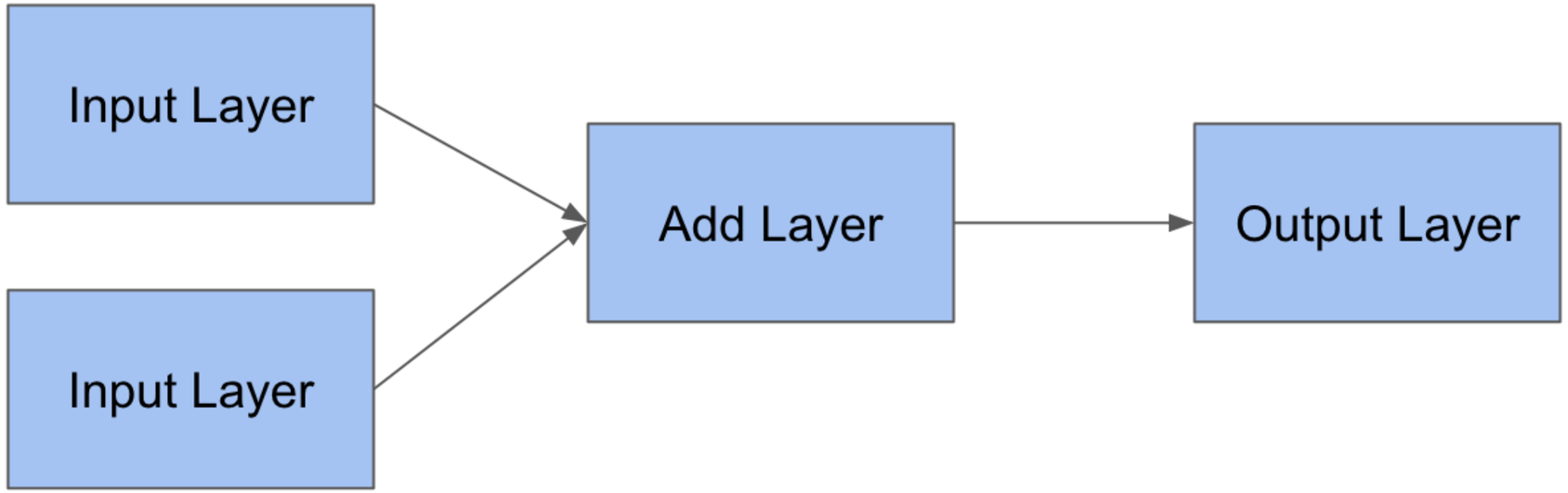
Merge layers

```
from keras.layers import Input, Add
in_tensor_1 = Input((1,))
in_tensor_2 = Input((1,))
out_tensor = Add()([in_tensor_1, in_tensor_2])
```



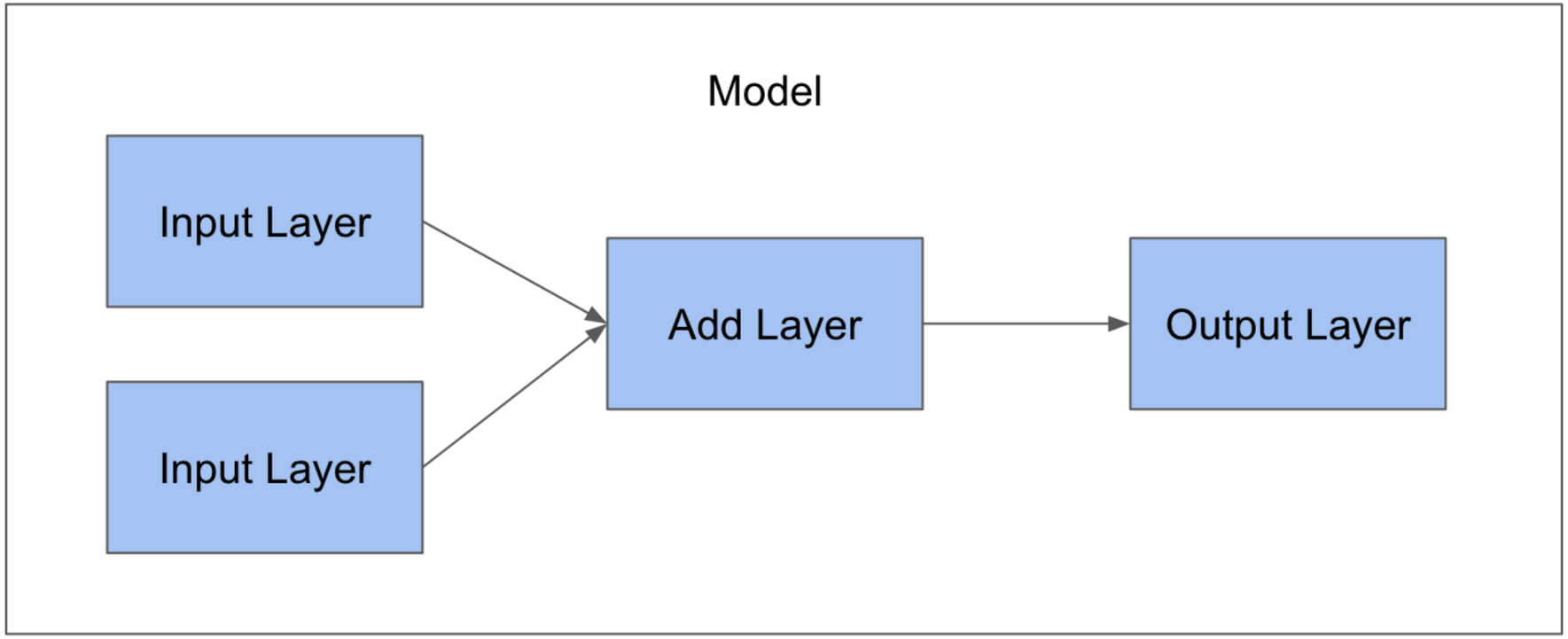
Merge layers

```
in_tensor_3 = Input((1,))
out_tensor = Add()([in_tensor_1, in_tensor_2, in_tensor_3])
```



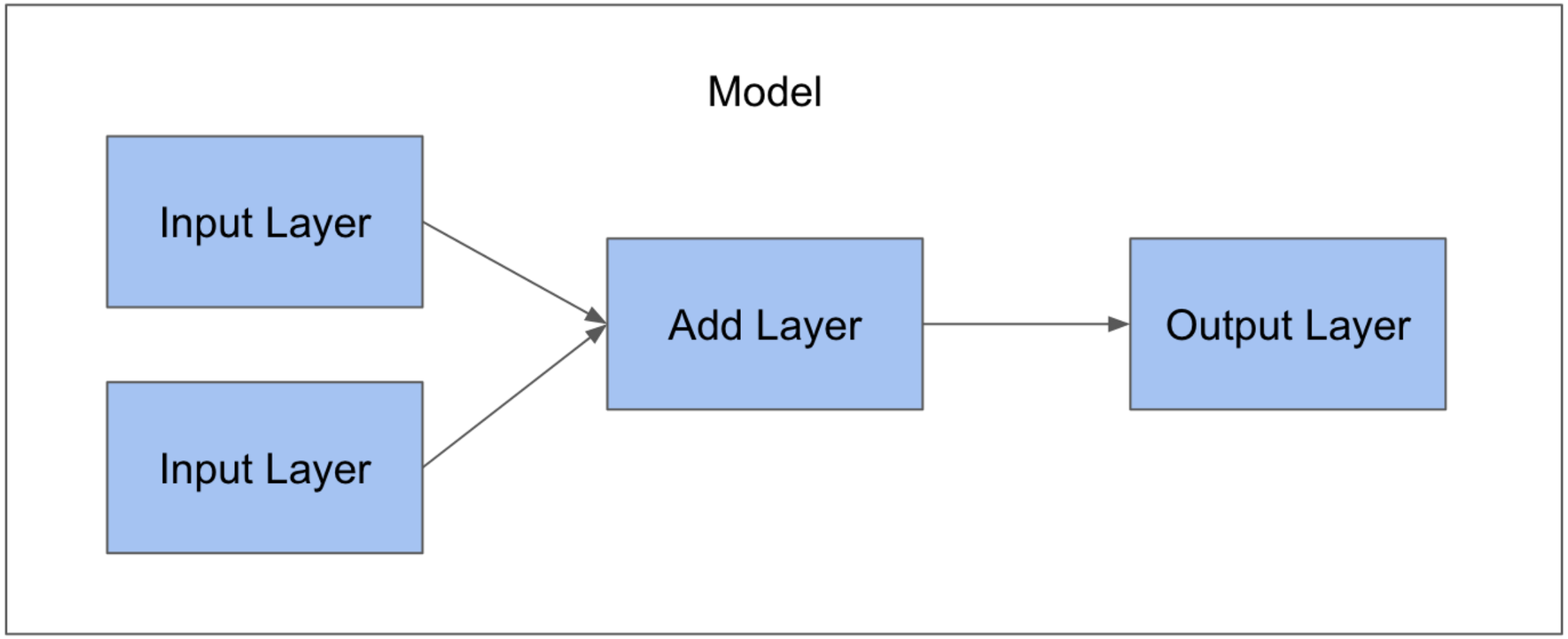
Create the model

```
from keras.models import Model
model = Model([in_tensor_1, in_tensor_2], out_tensor)
```



Compile the model

```
model.compile(optimizer='adam', loss='mean_absolute_error')
```



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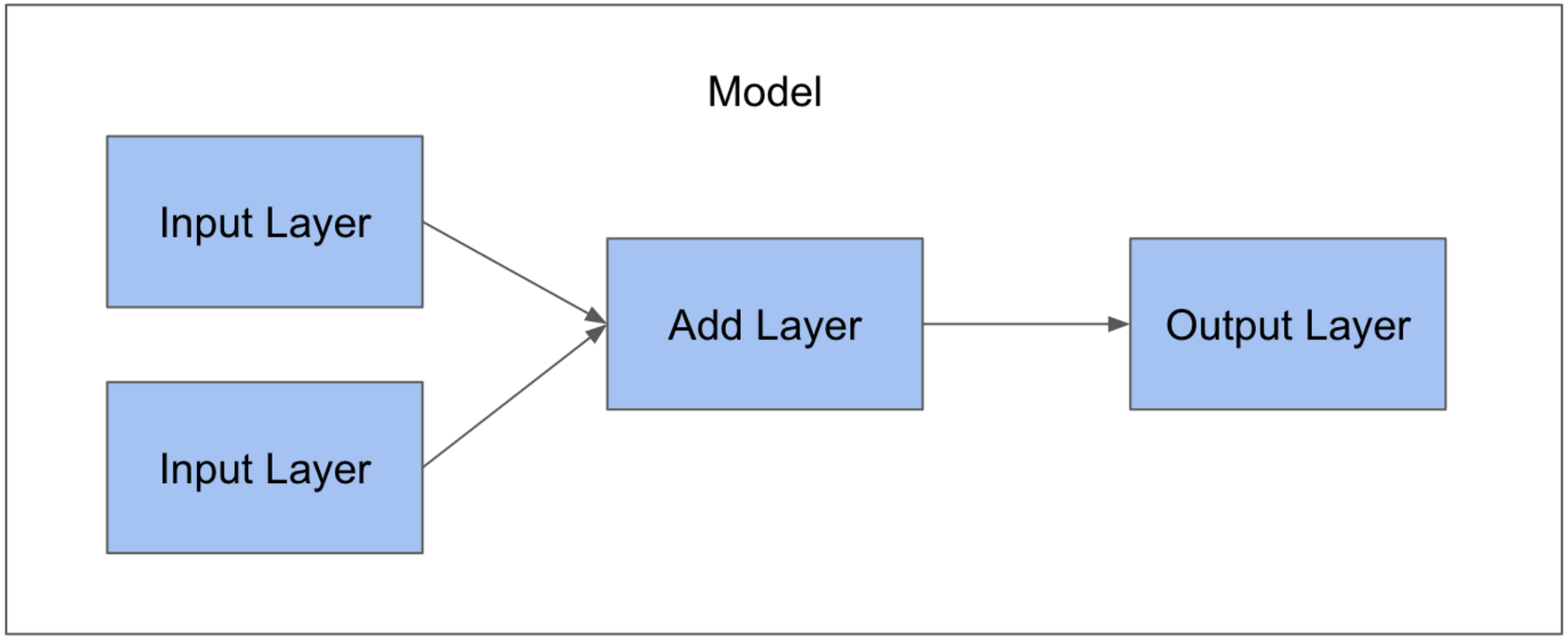
Fitting and Predicting with multiple inputs

Zach Deane Mayer
Data Scientist

Fit with multiple inputs

```
model.fit([data_1, data_2], target)
```



Predict with multiple inputs

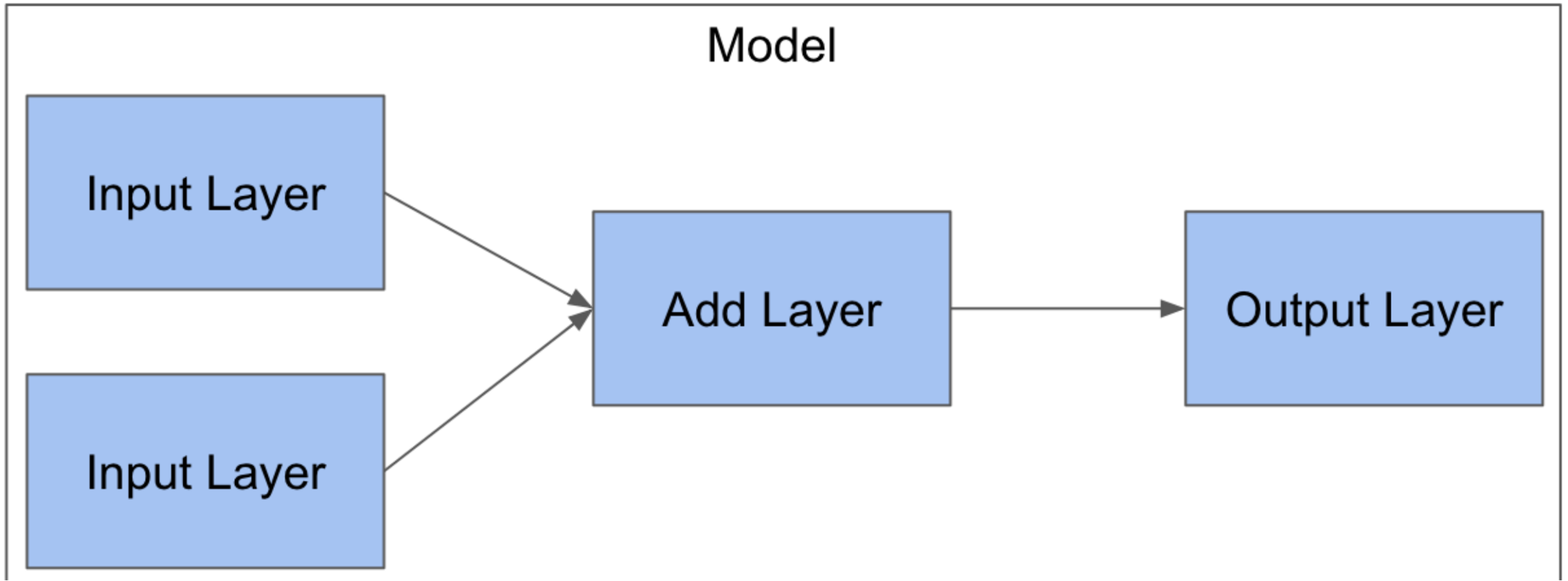
```
model.predict([np.array([[1]]), np.array([[2]])])
array([[3.]], dtype=float32)
```

```
model.predict([np.array([[42]]), np.array([[119]])])
array([[161.]], dtype=float32)
```

Evaluate with multiple inputs

```
model.evaluate([np.array([[-1]]), np.array([[-2]])], np.ar
```

```
1/1 [==============================] - 0s 801us/step
Out[21]: 0.0
```



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