

Three-input models

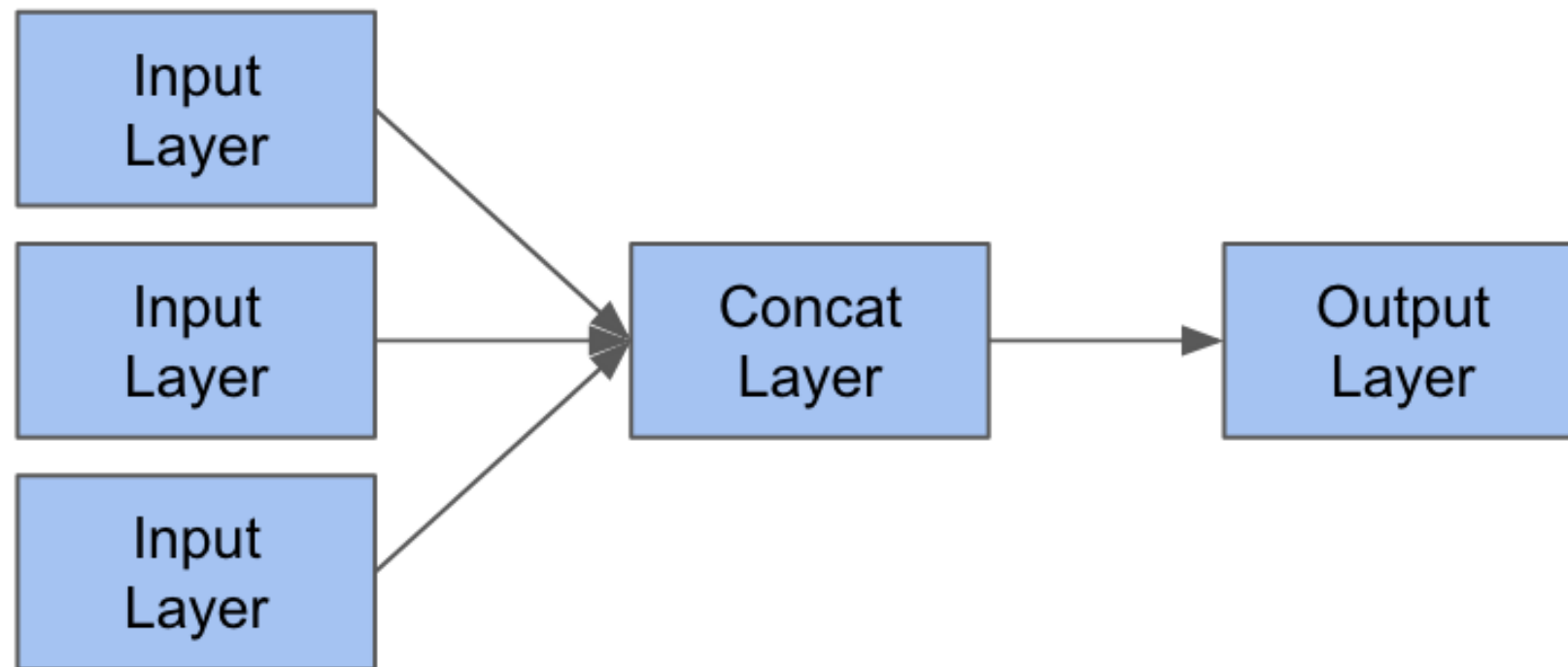
ADVANCED DEEP LEARNING WITH KERAS



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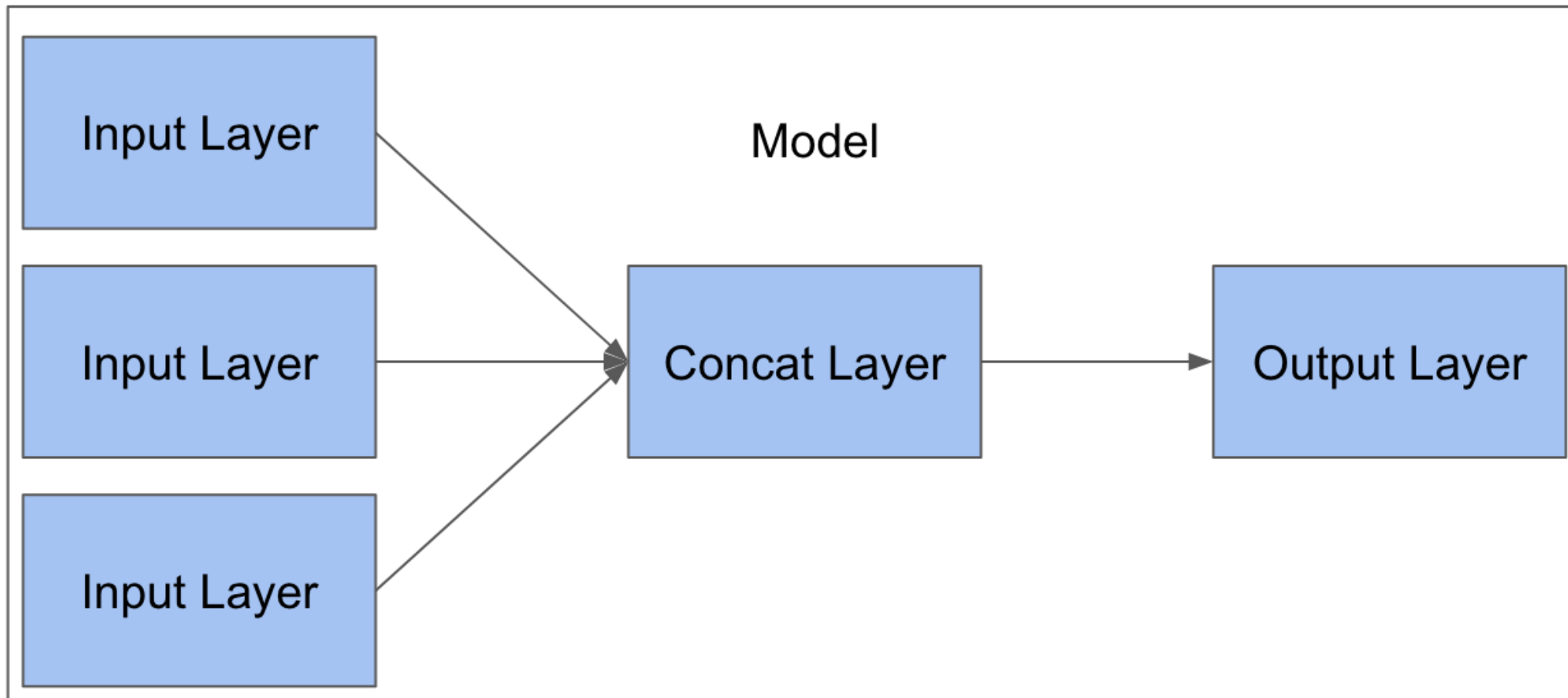
Simple model with 3 inputs

```
from tensorflow.keras.layers import Input, Concatenate, Dense
in_tensor_1 = Input(shape=(1,))
in_tensor_2 = Input(shape=(1,))
in_tensor_3 = Input(shape=(1,))
out_tensor = Concatenate()([in_tensor_1, in_tensor_2, in_tensor_3])
output_tensor = Dense(1)(out_tensor)
```



Simple model with 3 inputs

```
from tensorflow.keras.models import Model
model = Model([in_tensor_1, in_tensor_2, in_tensor_3], out_tensor)
```

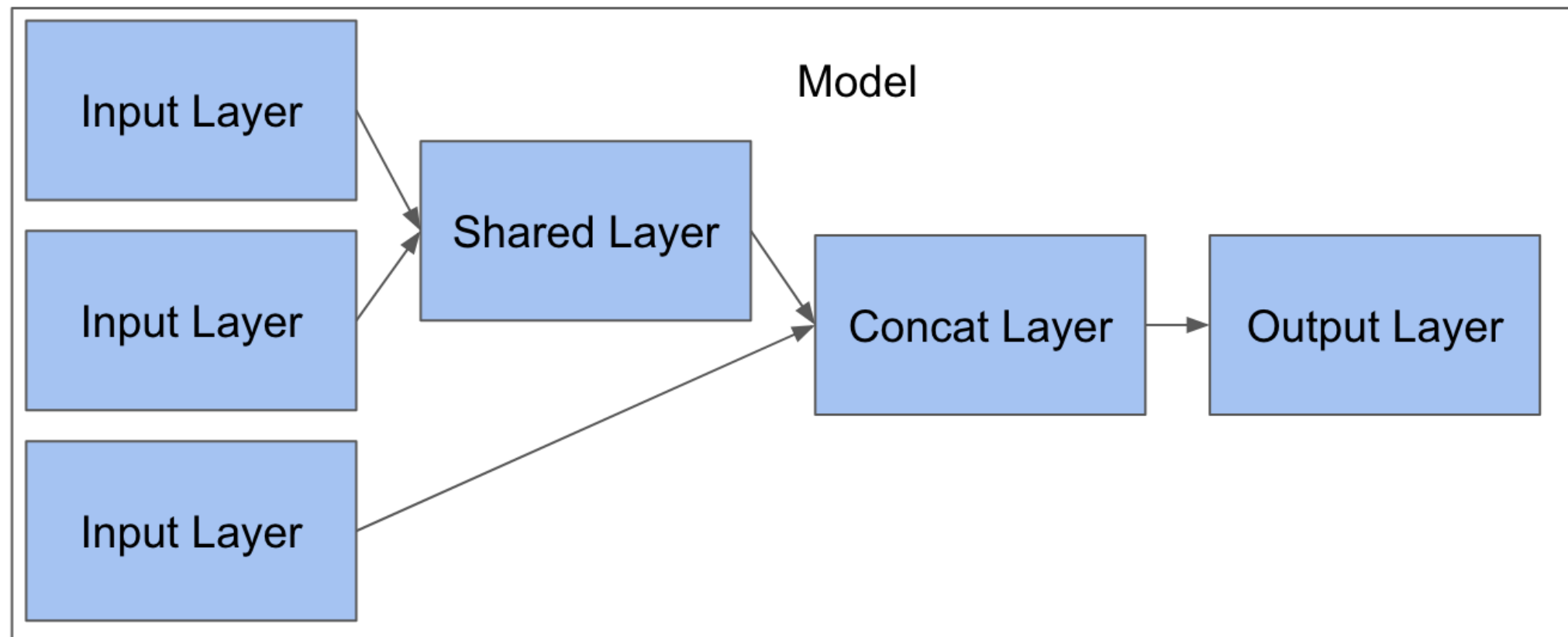


Shared layers with 3 inputs

```
shared_layer = Dense(1)
shared_tensor_1 = shared_layer(in_tensor_1)
shared_tensor_2 = shared_layer(in_tensor_1)
out_tensor = Concatenate()([shared_tensor_1, shared_tensor_2, in_tensor_3])
out_tensor = Dense(1)(out_tensor)
```

Shared layers with 3 inputs

```
from tensorflow.keras.models import Model
model = Model([in_tensor_1, in_tensor_2, in_tensor_3], out_tensor)
```



Fitting a 3 input model

```
from tensorflow.keras.models import Model
model = Model([in_tensor_1, in_tensor_2, in_tensor_3], out_tensor)
model.compile(loss='mae', optimizer='adam')
```

```
model.fit([[train['col1'], train['col2'], train['col3']],
          train_data['target']])
```

```
model.evaluate([[test['col1'], test['col2'], test['col3']],
                test['target']])
```

Let's practice

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Summarizing and plotting models

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Understanding a model summary

```
Model: "model"

-----
Layer (type)                Output Shape          Param #    Connected to
-----
input_1 (InputLayer)        [(None, 1)]           0          []
input_3 (InputLayer)        [(None, 1)]           0          []
input_3 (InputLayer)        [(None, 1)]           0          []
concatenate (Concatenate)   (None, 3)             0          ['input_1[0][0]',
                                     'input_2[0][0]',
                                     'input_3[0][0]']
dense (Dense)               (None, 1)             4          ['concatenate[0][0]']

=====
Total params: 4
Trainable params: 4
Non-trainable params: 0
-----
```

Understanding a model summary

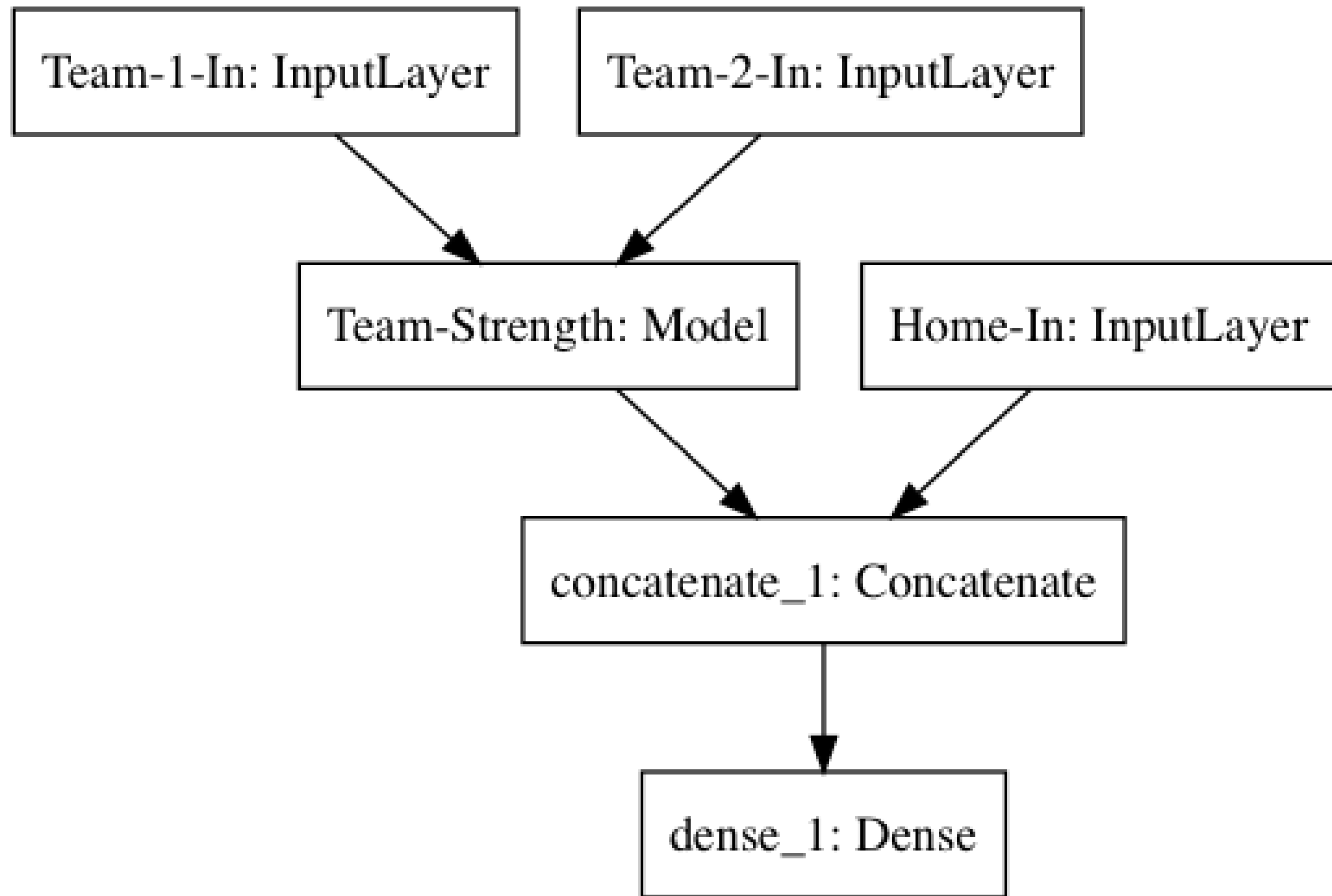
Model: "model"

Layer (type)	Output Shape	Param #	Connected to
input_1 (InputLayer)	[(None, 1)]	0	[]
embedding (Embedding)	(None, 1, 1)	10887	['input_1[0][0]']
flatten (Flatten)	(None, 1)	0	['embedding[0][0]']
input_2 (InputLayer)	[(None, 1)]	0	[]
input_3 (InputLayer)	[(None, 1)]	0	[]
concatenate (Concatenate)	(None, 3)	0	['flatten[0][0]', 'input_2[0][0]', 'input_3[0][0]']
dense (Dense)	(None, 1)	4	['concatenate[0][0]']

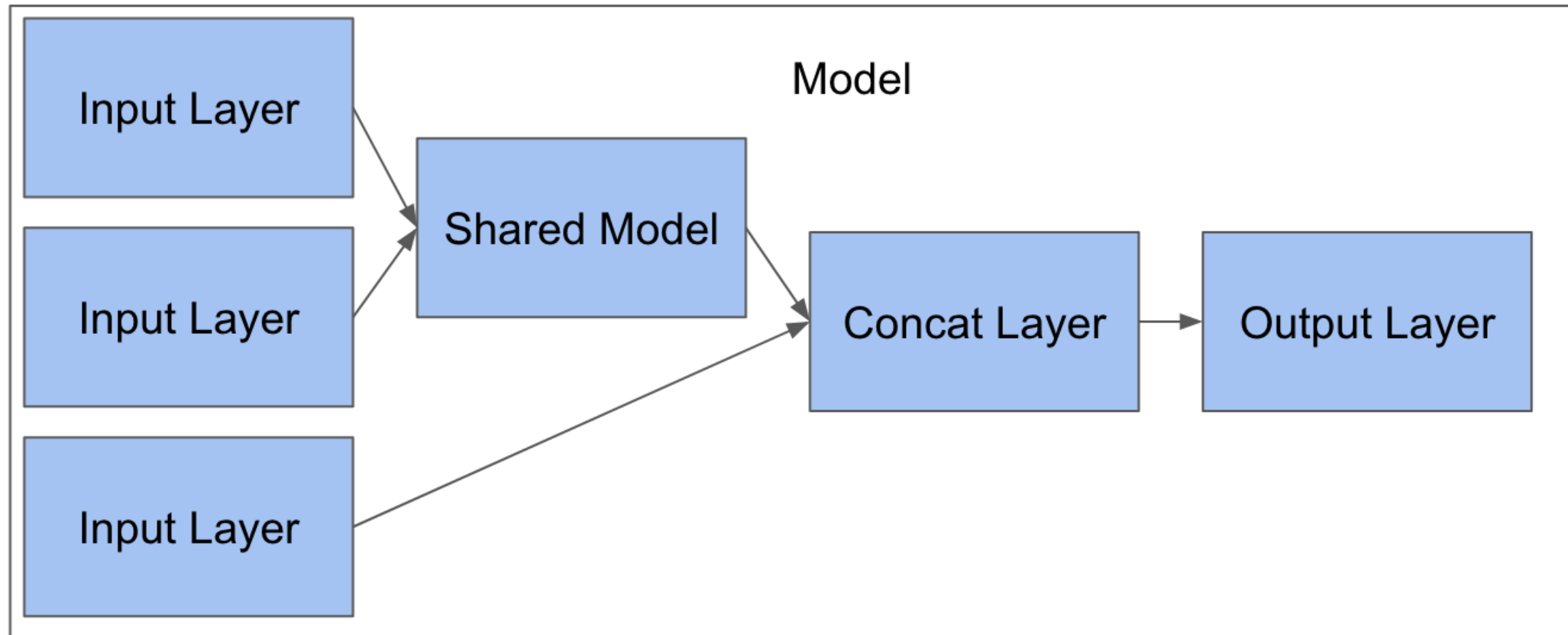
Total params: 10,891

Trainable params: 10,891

Non-trainable params: 0



Understanding a model plot!



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Stacking models

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Stacking models requires 2 datasets

```
from pandas import read_csv
games_season = read_csv('datasets/games_season.csv')
games_season.head()
```

	team_1	team_2	home	score_diff
0	3745	6664	0	17
1	126	7493	1	7
2	288	3593	1	7
3	1846	9881	1	16
4	2675	10298	1	12

```
games_tourney = read_csv('datasets/games_tourney.csv')
games_tourney.head()
```

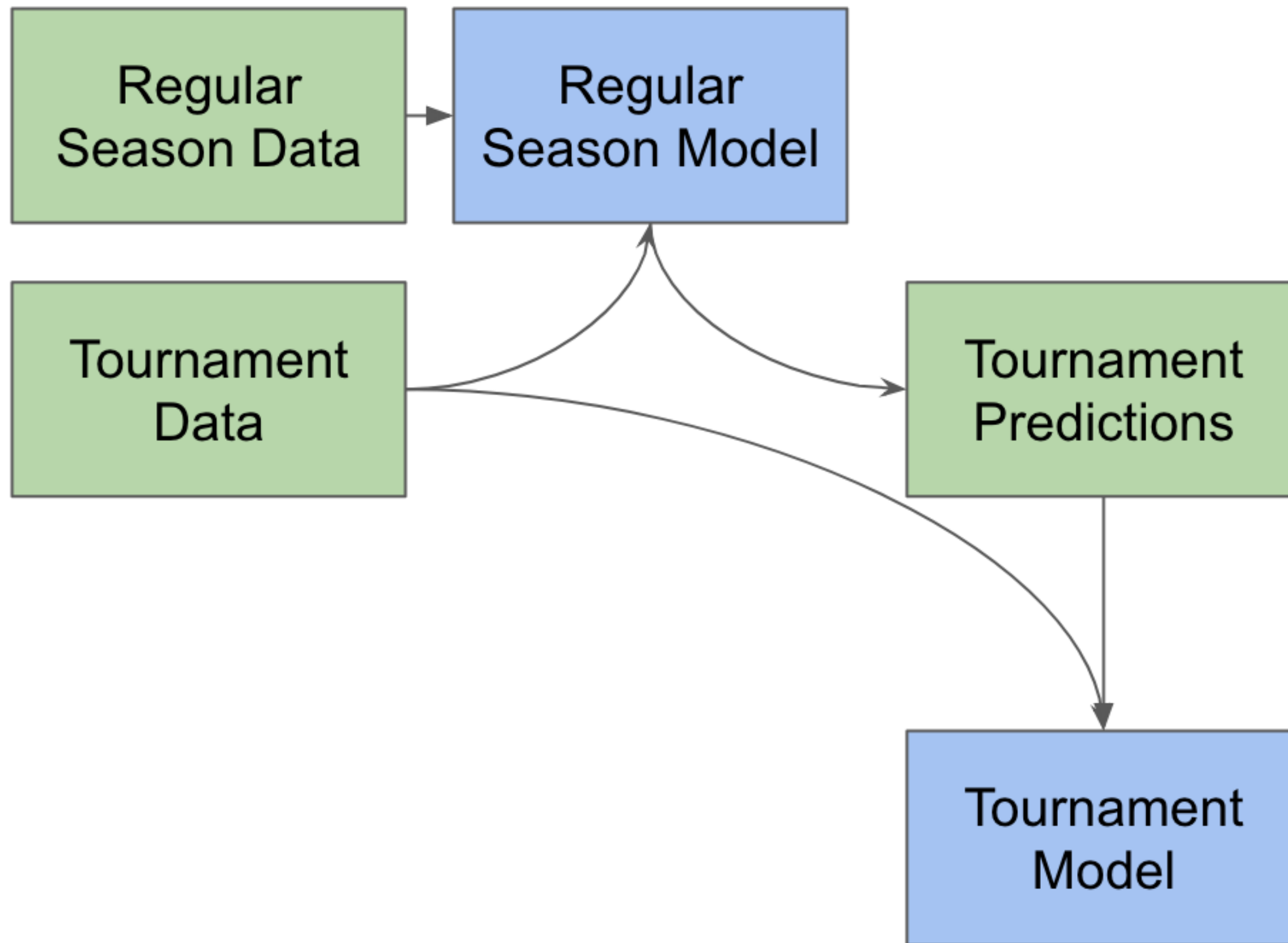
	team_1	team_2	home	seed_diff	score_diff
0	288	73	0	-3	-9
1	5929	73	0	4	6
2	9884	73	0	5	-4
3	73	288	0	3	9
4	3920	410	0	1	-9

Enrich the tournament data

```
in_data_1 = games_tourney['team_1']
in_data_2 = games_tourney['team_2']
in_data_3 = games_tourney['home']
pred = regular_season_model.predict([in_data_1, in_data_2, in_data_3])
```

```
games_tourney['pred'] = pred
games_tourney.head()
```

	team_1	team_2	home	seed_diff	pred	score_diff
0	288	73	0	-3	0.582556	-9
1	5929	73	0	4	0.707279	6
2	9884	73	0	5	1.364844	-4
3	73	288	0	3	0.699145	9
4	3920	410	0	1	0.833066	-9

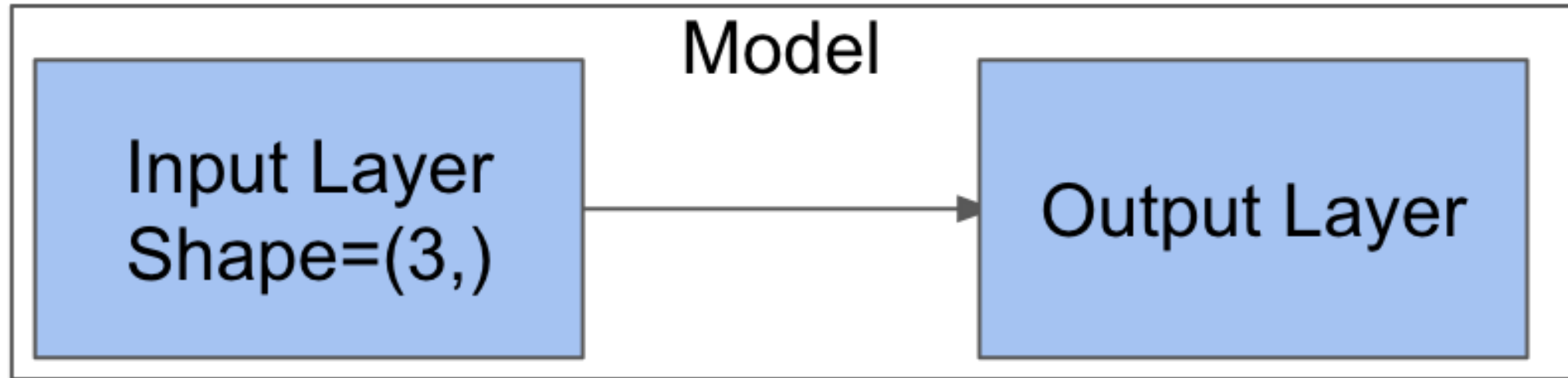


3 input model with pure numeric data

```
games_tourney[['home', 'seed_diff', 'pred']].head()
```

	home	seed_diff	pred
0	0	-3	0.582556
1	0	4	0.707279
2	0	5	1.364844
3	0	3	0.699145
4	0	1	0.833066

3 input model with pure numeric data



3 input model with pure numeric data

```
from tensorflow.keras.layers import Input, Dense
in_tensor = Input(shape=(3,))
out_tensor = Dense(1)(in_tensor)
```

```
from tensorflow.keras.models import Model
model = Model(in_tensor, out_tensor)
model.compile(optimizer='adam', loss='mae')
train_X = train_data[['home', 'seed_diff', 'pred']]
train_y = train_data['score_diff']
model.fit(train_X, train_y, epochs=10, validation_split=.10)
```

```
test_X = test_data[['home', 'seed_diff', 'pred']]
test_y = test_data['score_diff']
model.evaluate(test_X, test_y)
1066/1066 [=====] - 0s 14us/step
9.11321775461451
```

Let's practice!

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