In [163]:
```
import matplotlib.pyplot as plt
```

In [164]:
```
def plot_loss_ppl(filepath):
    train_losses, train_ppls, val_losses, val_ppls = [], [], [], []
    with open(filepath, 'r', encoding='utf-8') as f:
        for line in f:
            line = line.strip()
            if line.startswith('| end of epoch'):
                segments = line.split('|')
                train_losses.append(float(segments[3].split()[-1]))
                train_ppls.append(float(segments[4].split()[-1]))
                val_losses.append(float(segments[5].split()[-1]))
                val_ppls.append(float(segments[6].split()[-1]))
    assert len(train_losses) == len(train_ppls) == len(val_losses) == len(val_
ppls)

    # plot
    fig, axs = plt.subplots(nrows=1, ncols=2, figsize=(10, 4), dpi=160)
    # loss
    axs[0].plot(range(1, len(train_losses) + 1), train_losses, color='xkcd:gol
d', label='train')
    axs[0].plot(range(1, len(val_losses) + 1), val_losses, color='xkcd:cerulea
n', label='val')
    axs[0].set_title('loss as training progresses')
    axs[0].set_xlabel('epoch')
    axs[0].set_ylabel('loss')
    axs[0].legend()
    # perplexity
    axs[1].plot(range(1, len(train_ppls) + 1), train_ppls, color='xkcd:gold',
label='train')
    axs[1].plot(range(1, len(val_ppls) + 1), val_ppls, color='xkcd:cerulean',
label='val')
    axs[1].set_title('perplexity as training progresses')
    axs[1].set_xlabel('epoch')
    axs[1].set_ylabel('perplexity')
    axs[1].legend()
    plt.show()
```

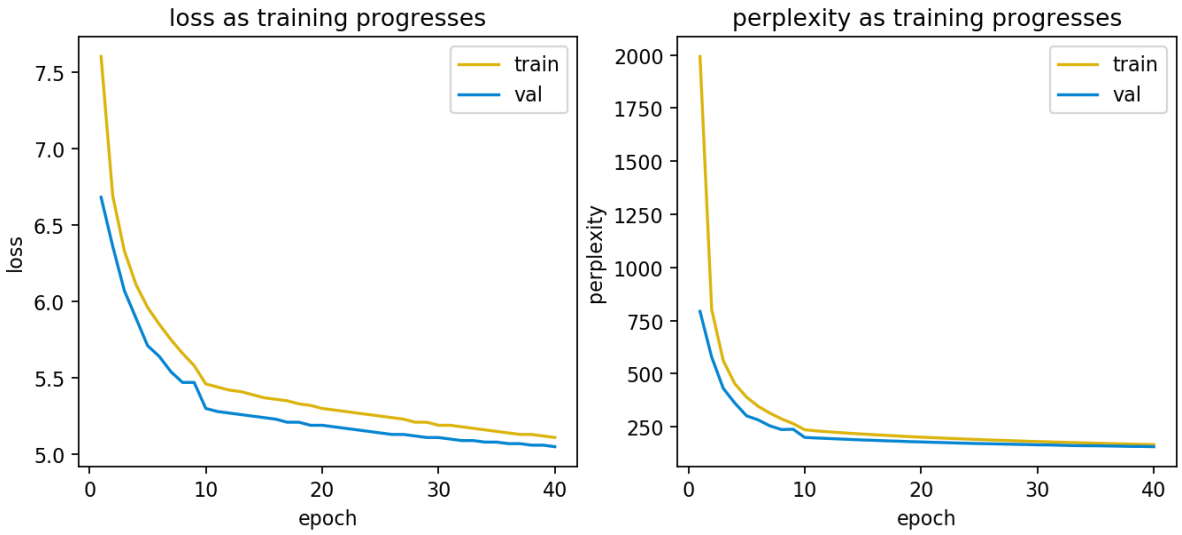
In [165]:
```
def get_min_val_ppl(filepath):
    val_ppls = []
    with open(filepath, 'r', encoding='utf-8') as f:
        for line in f:
            line = line.strip()
            if line.startswith('| end of epoch'):
                segments = line.split('|')
                val_ppls.append(float(segments[6].split()[-1]))

    return min(val_ppls)
```

In [166]:
```
def show_min_val_ppl(filepath):
    # plot
    plt.figure(figsize=(10, 1), dpi=160)
    plt.text(0.35, 0.5, f"minimum val perplexity: {get_min_val_ppl(filepath)}"
, fontweight='bold', color='xkcd:merlot')
    plt.axis('off')
    plt.show()
```

In [167]:
```
def show_heading(emsize, dropout_prob):
    # plot
    plt.figure(figsize=(10, 1), dpi=160)
    plt.text(0.0, 0.5, f"LSTM Model Embdedding Size {emsize}, Hidden Size {ems
ize}, Dropout {dropout_prob}",
             fontweight='bold', fontsize=14)
    plt.axis('off')
    plt.show()
```

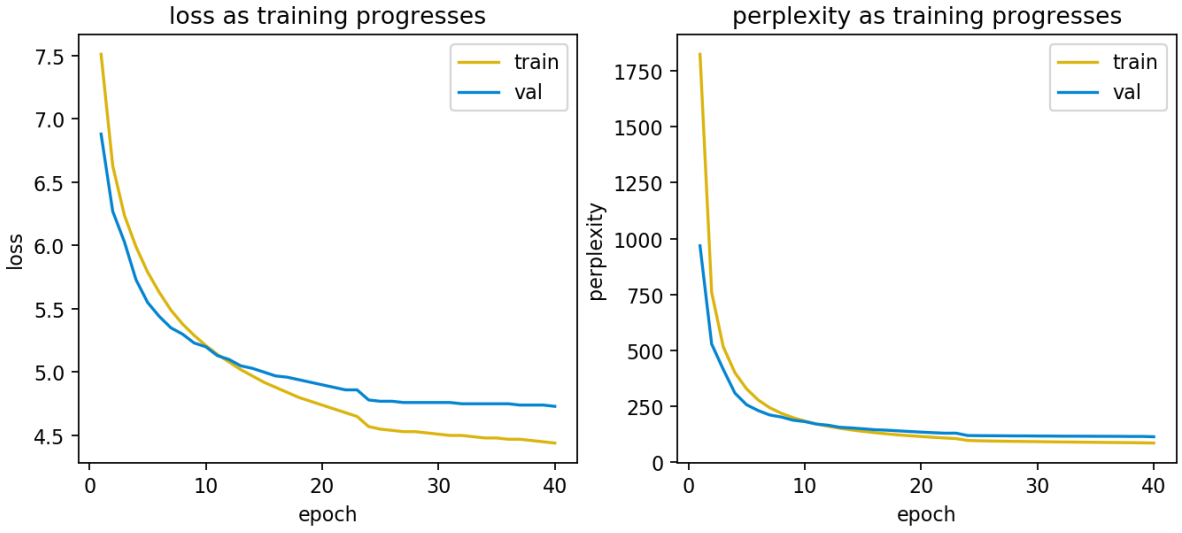
In [168]:
```
for dropout_prob in [0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8]:
    for emsize in [100, 200, 300]:
        show_heading(emsize, dropout_prob)
        filename = f'logs/lstm_emsize{emsize}_dropout{dropout_prob}_tied.txt'
        plot_loss_ppl(filename)
        show_min_val_ppl(filename)
```

LSTM Model Embdedding Size 100, Hidden Size 100, Dropout 0.2



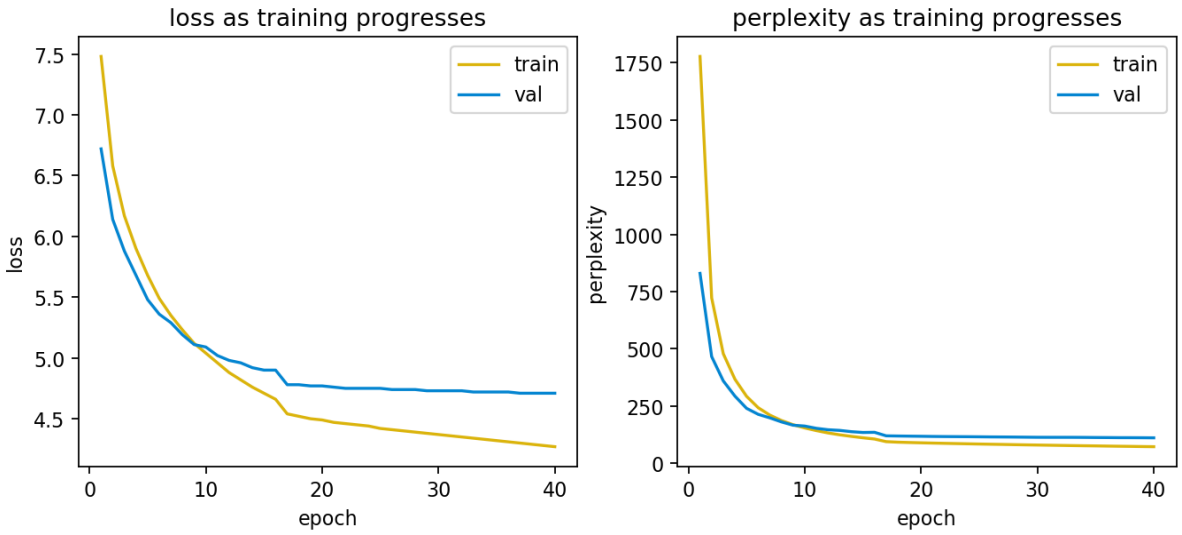
minimum val perplexity: 156.22

LSTM Model Embdedding Size 200, Hidden Size 200, Dropout 0.2



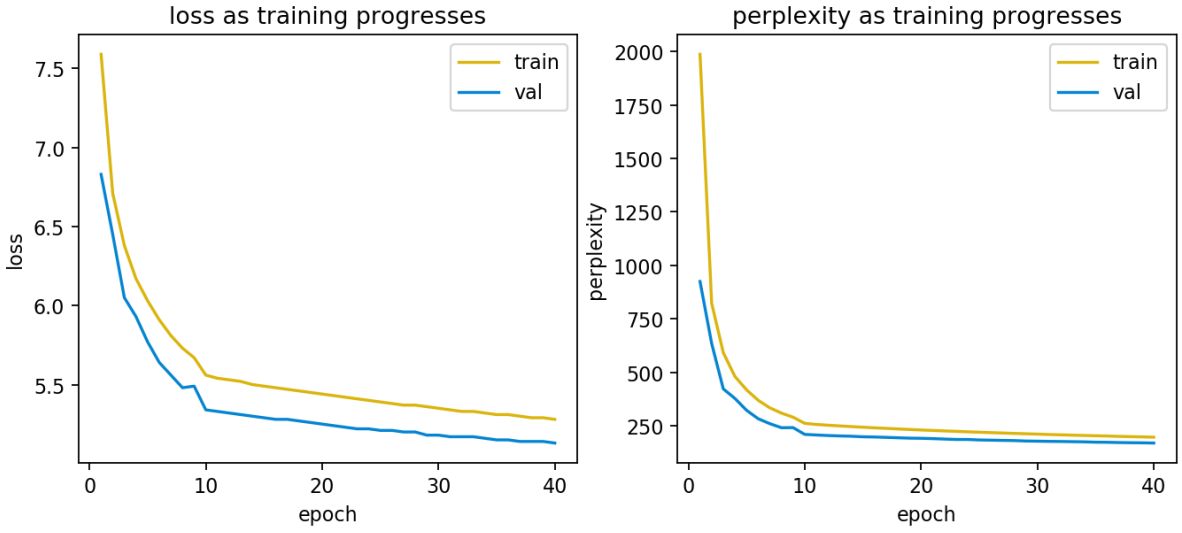
minimum val perplexity: 113.01

LSTM Model Embdedding Size 300, Hidden Size 300, Dropout 0.2



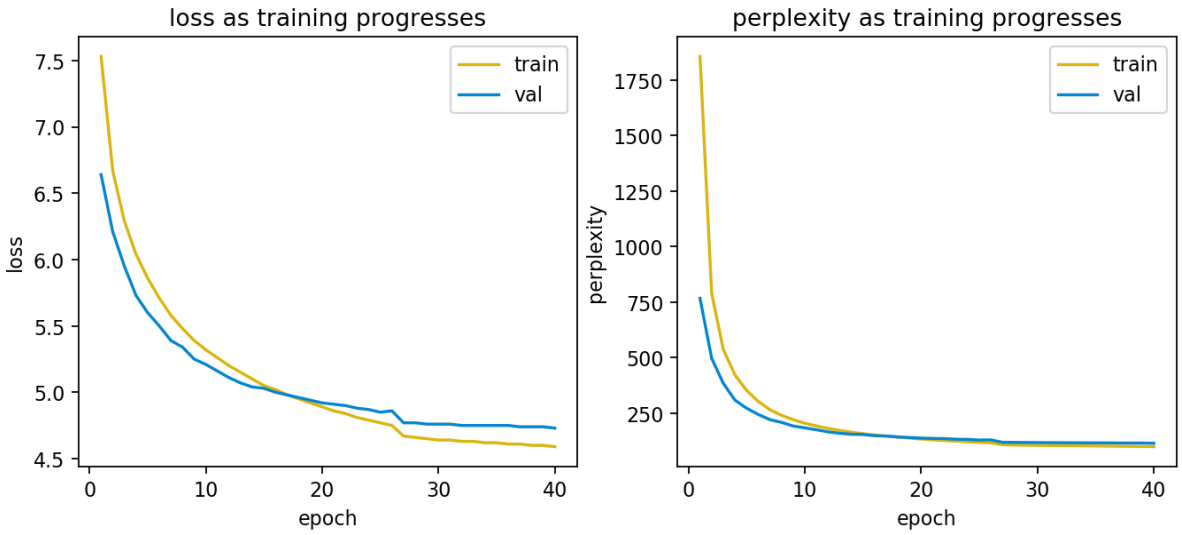
minimum val perplexity: 110.59

LSTM Model Embdedding Size 100, Hidden Size 100, Dropout 0.3



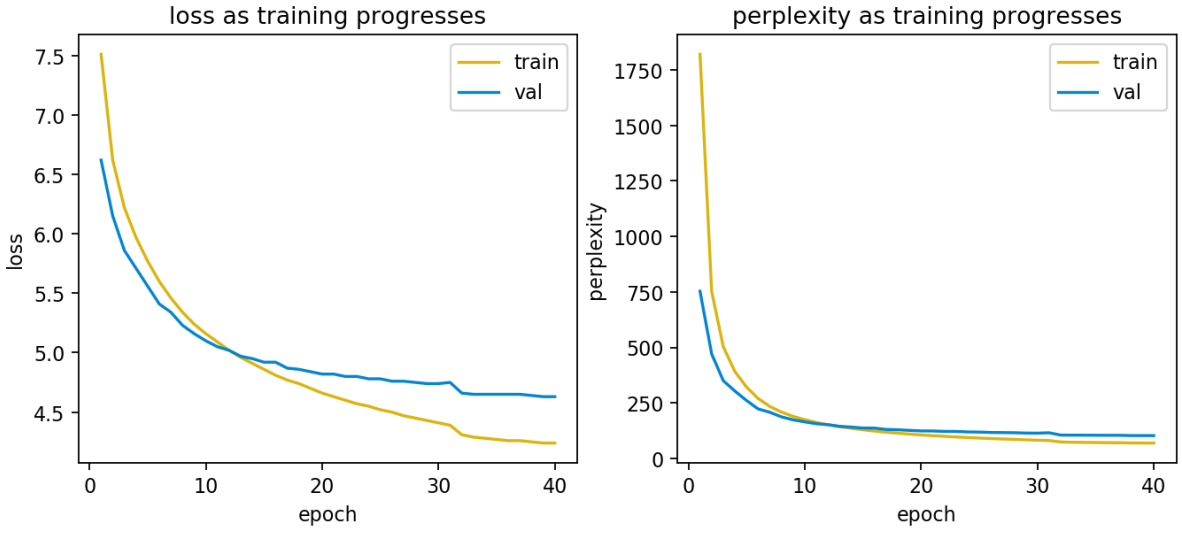
minimum val perplexity: 168.84

LSTM Model Embdedding Size 200, Hidden Size 200, Dropout 0.3



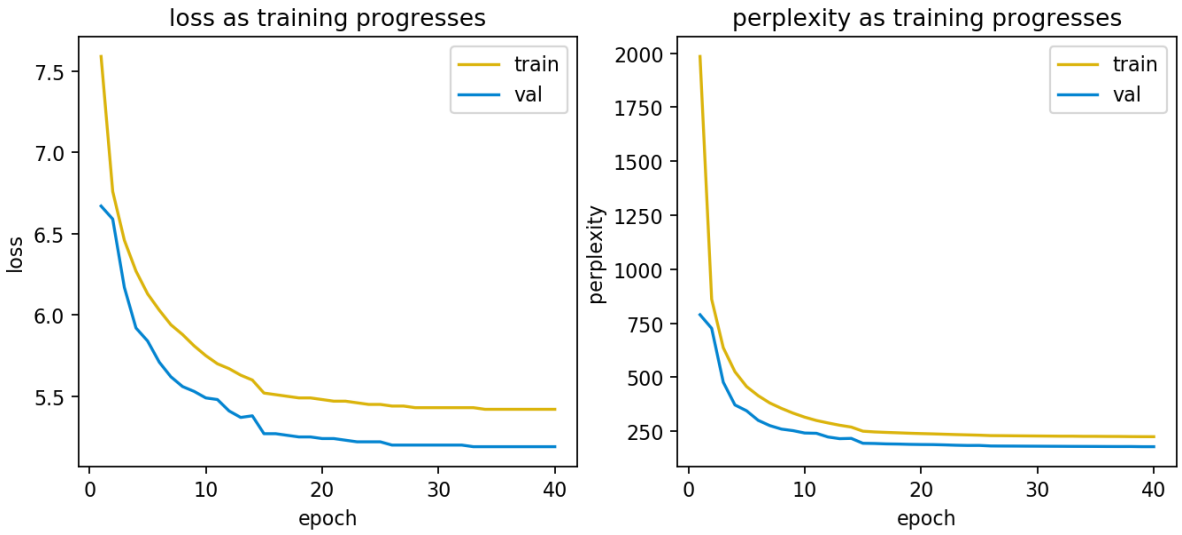
minimum val perplexity: 113.43

LSTM Model Embdedding Size 300, Hidden Size 300, Dropout 0.3



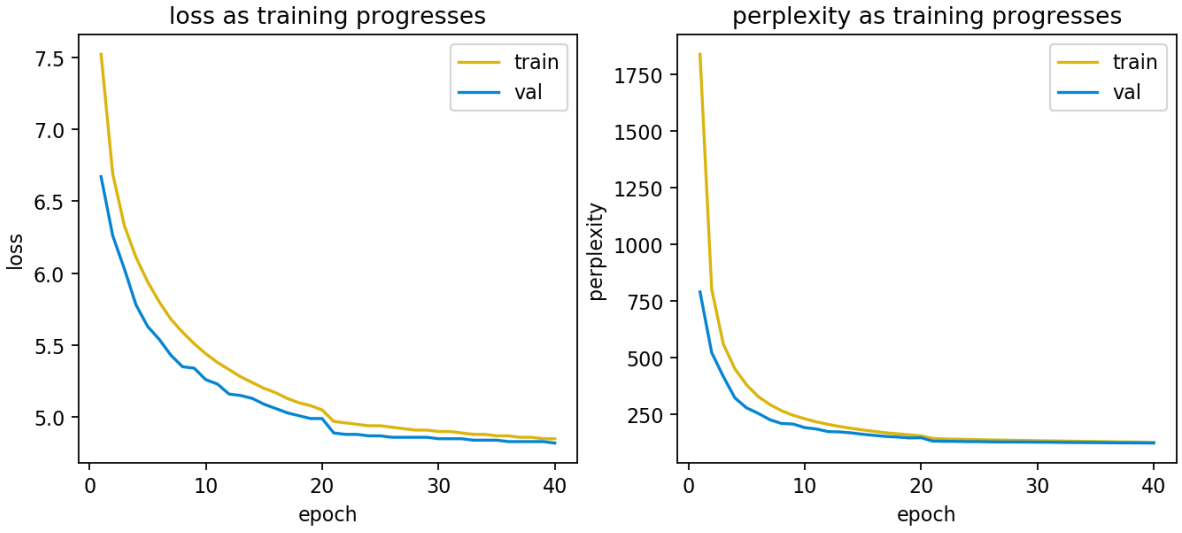
minimum val perplexity: 102.83

LSTM Model Embdedding Size 100, Hidden Size 100, Dropout 0.4



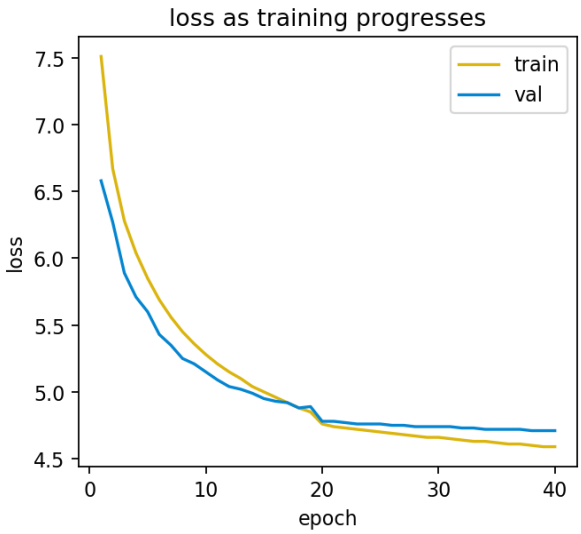
minimum val perplexity: 178.74

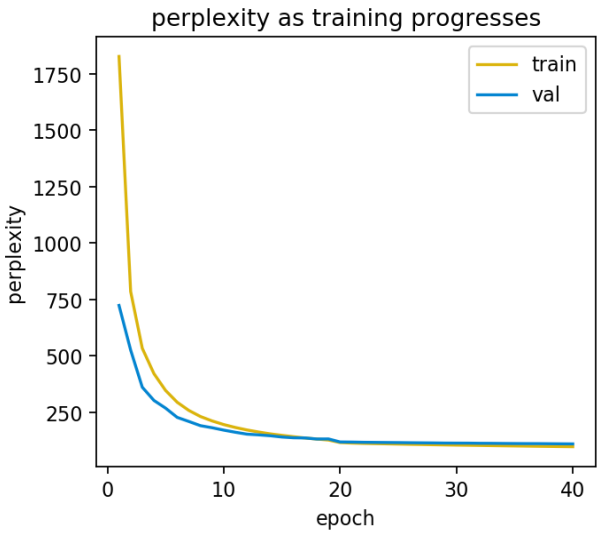
LSTM Model Embdedding Size 200, Hidden Size 200, Dropout 0.4



minimum val perplexity: 124.21

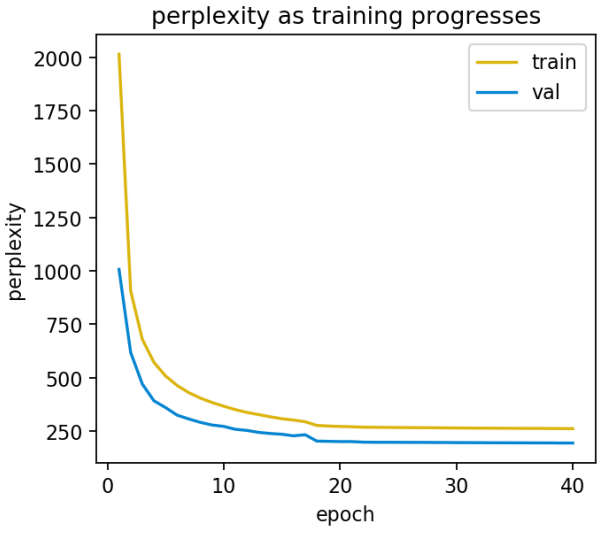
LSTM Model Embdedding Size 300, Hidden Size 300, Dropout 0.4





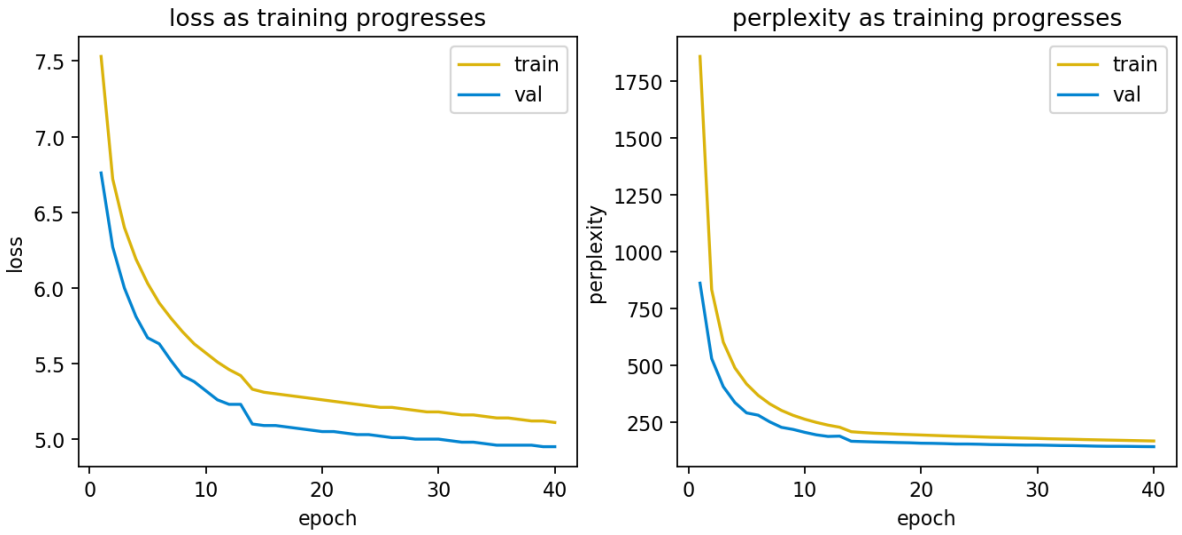
minimum val perplexity: 110.64

LSTM Model Embdedding Size 100, Hidden Size 100, Dropout 0.5



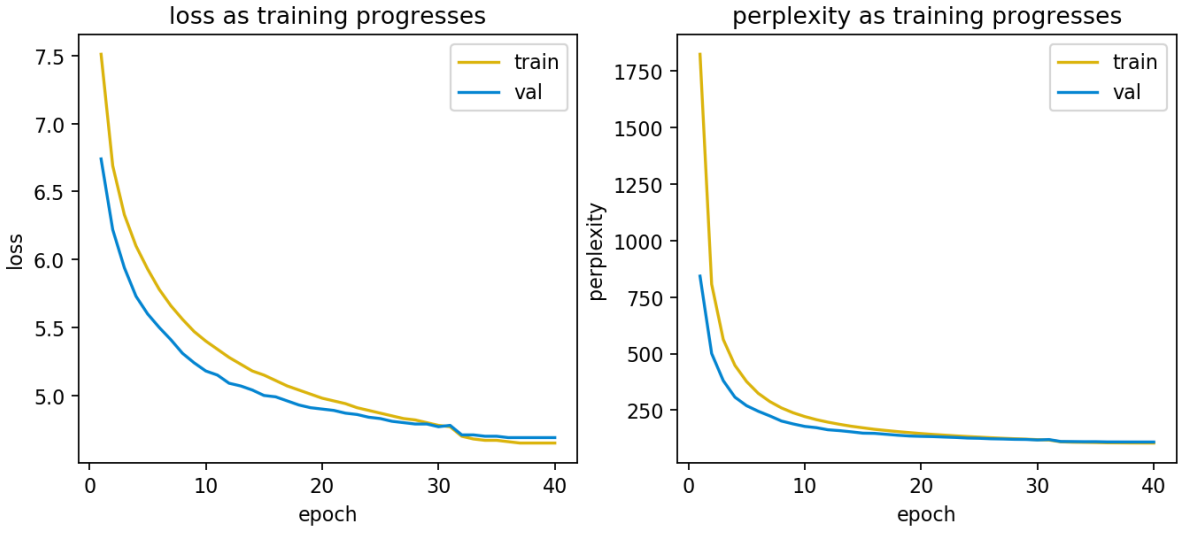
minimum val perplexity: 193.09

LSTM Model Embdedding Size 200, Hidden Size 200, Dropout 0.5



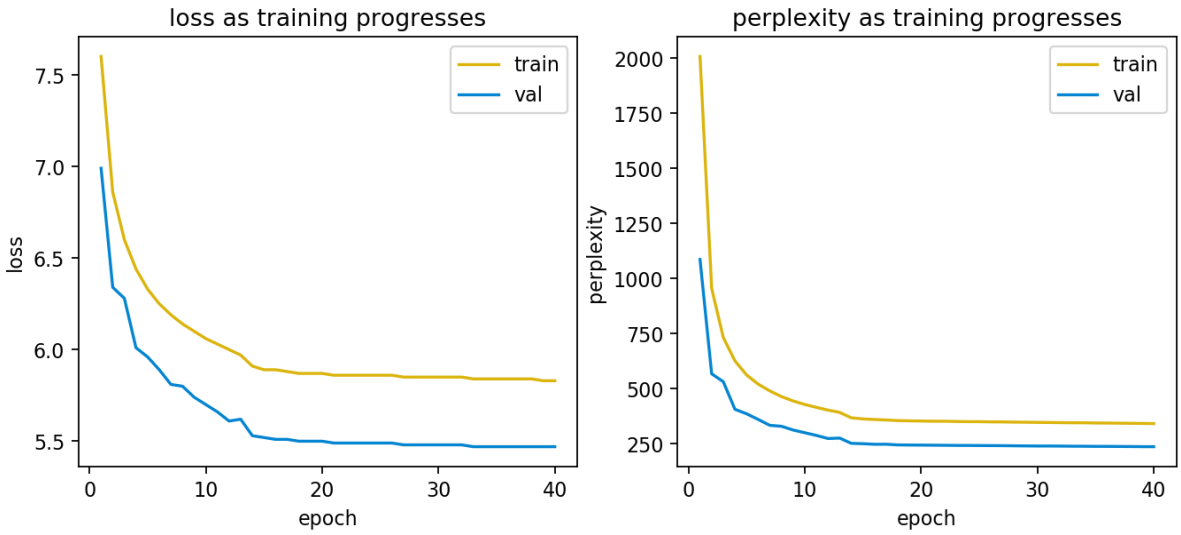
minimum val perplexity: 140.75

LSTM Model Embdedding Size 300, Hidden Size 300, Dropout 0.5



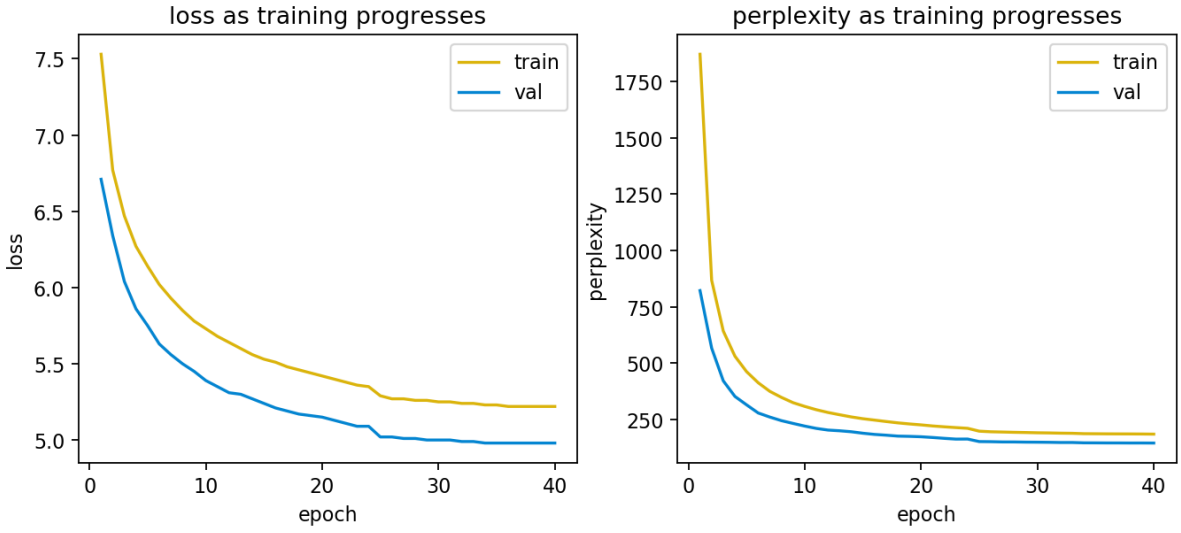
minimum val perplexity: 108.8

LSTM Model Embdedding Size 100, Hidden Size 100, Dropout 0.6



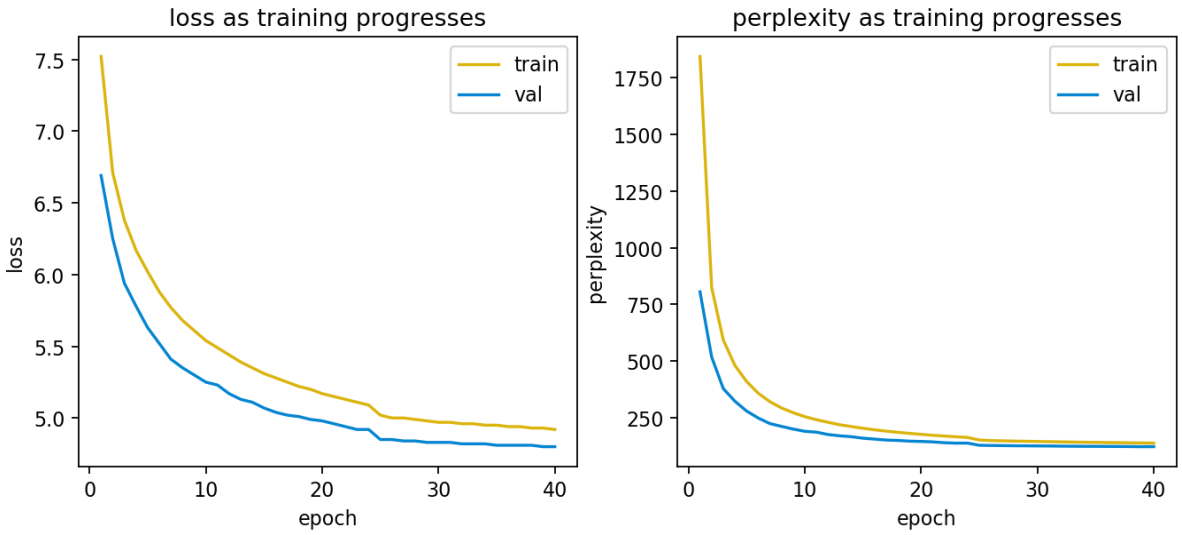
minimum val perplexity: 236.41

LSTM Model Embdedding Size 200, Hidden Size 200, Dropout 0.6



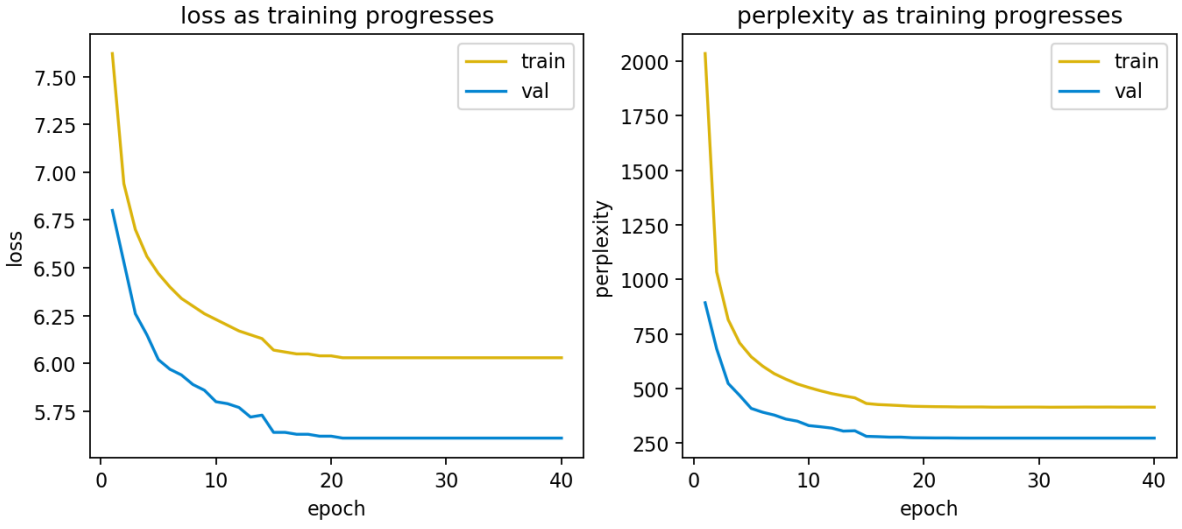
minimum val perplexity: 144.91

LSTM Model Embdedding Size 300, Hidden Size 300, Dropout 0.6



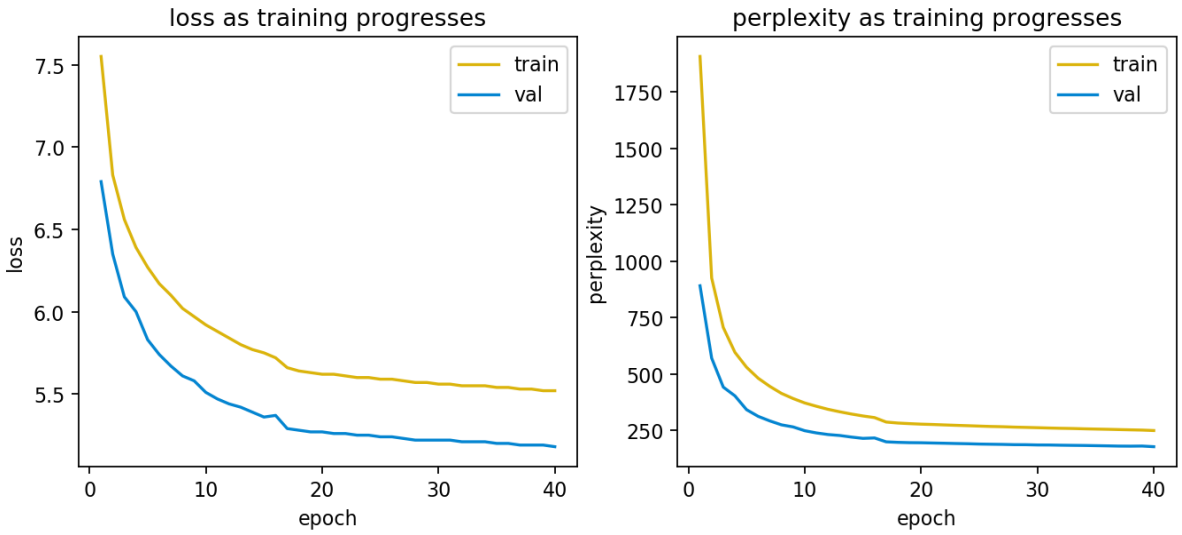
minimum val perplexity: 121.81

LSTM Model Embdedding Size 100, Hidden Size 100, Dropout 0.7



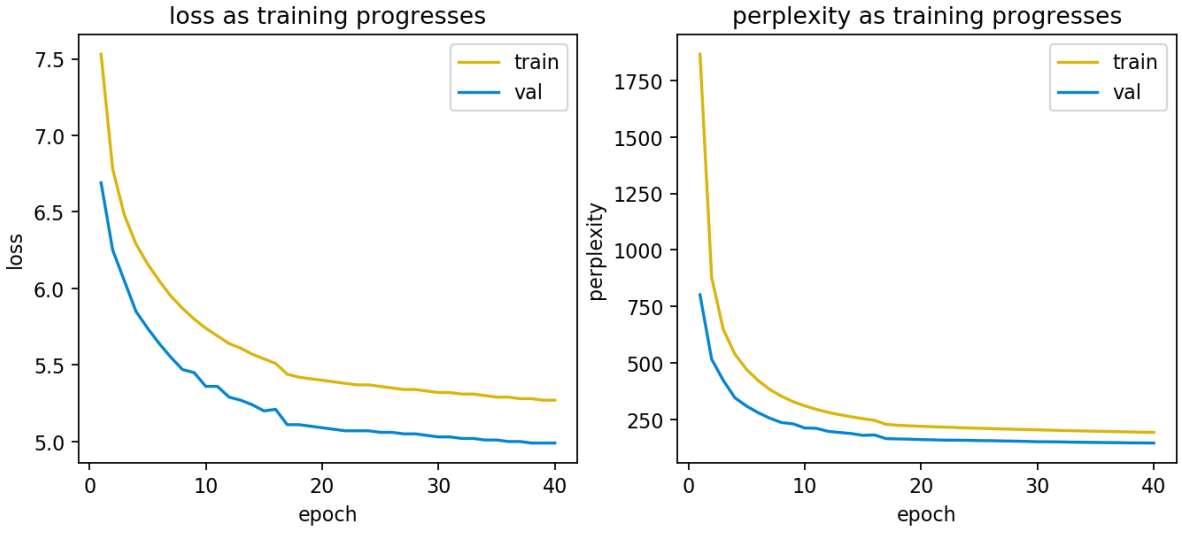
minimum val perplexity: 273.66

LSTM Model Embdedding Size 200, Hidden Size 200, Dropout 0.7



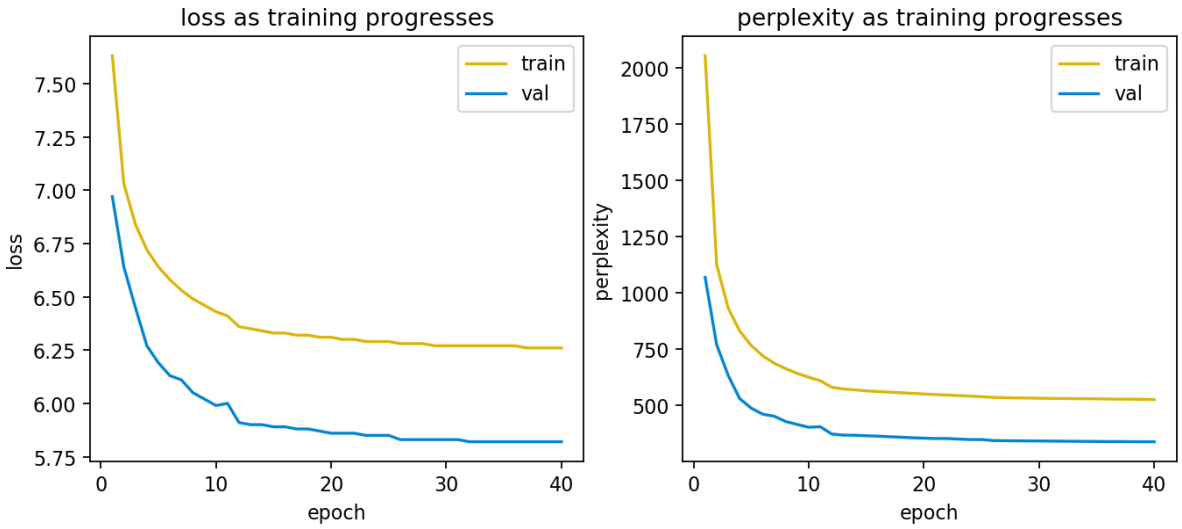
minimum val perplexity: 176.81

LSTM Model Embdedding Size 300, Hidden Size 300, Dropout 0.7



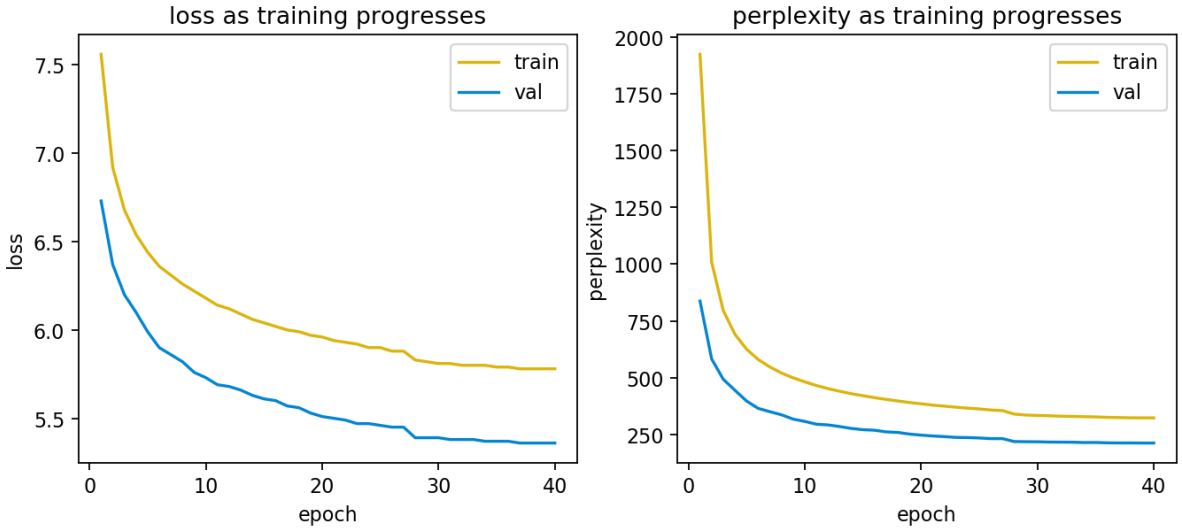
minimum val perplexity: 146.94

LSTM Model Embdedding Size 100, Hidden Size 100, Dropout 0.8



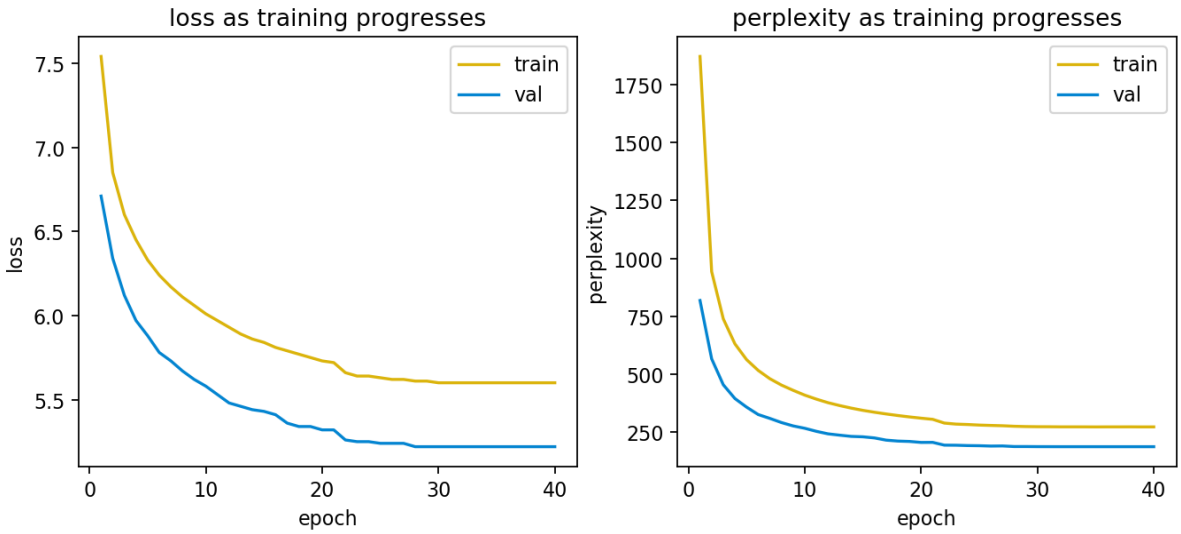
minimum val perplexity: 336.13

LSTM Model Embdedding Size 200, Hidden Size 200, Dropout 0.8



minimum val perplexity: 213.25

LSTM Model Embdedding Size 300, Hidden Size 300, Dropout 0.8

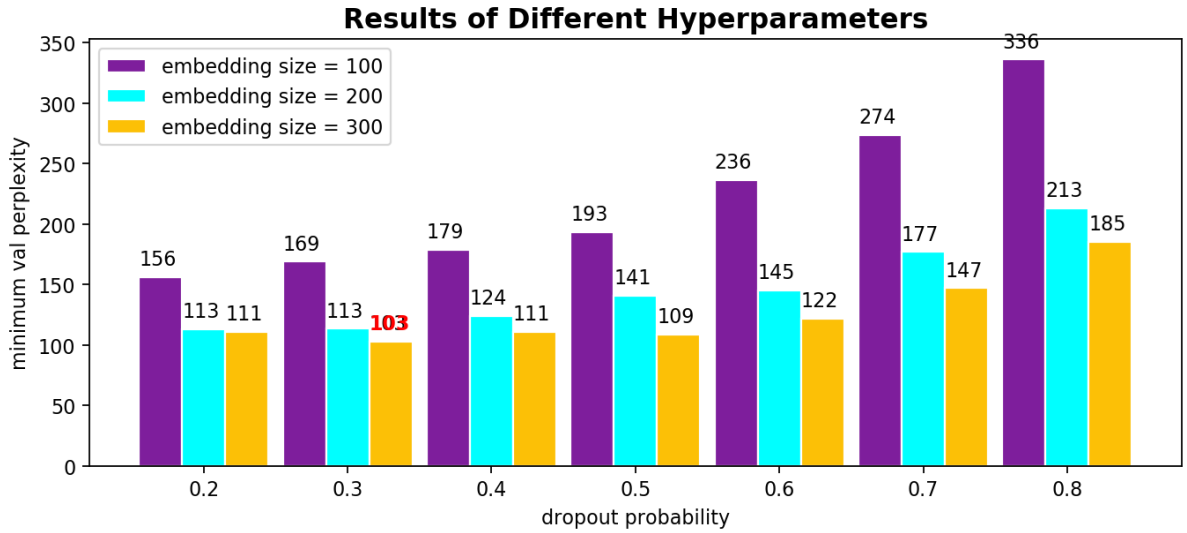


minimum val perplexity: 185.05

In [169]:

```
def multibar(dropout_probs):
    # plot
    plt.figure(figsize=(10, 4), dpi=160)
    # set width of bar
    barWidth = 0.3

    # set height of bar
    bar_emsize100 = list(get_min_val_ppl(f'logs/lstm_emsize{100}_dropout{dropo
ut_prob}_tied.txt')
                                            for dropout_prob in dropout_probs)
    bar_emsize200 = list(get_min_val_ppl(f'logs/lstm_emsize{200}_dropout{dropo
ut_prob}_tied.txt')
                                            for dropout_prob in dropout_probs)
    bar_emsize300 = list(get_min_val_ppl(f'logs/lstm_emsize{300}_dropout{dropo
ut_prob}_tied.txt')
                                            for dropout_prob in dropout_probs)

    # Set position of bar on X axis
    r1 = range(len(bar_emsize100))
    r2 = [x + barWidth for x in r1]
    r3 = [x + barWidth for x in r2]

    # Make the plot
    plt.bar(r1, bar_emsize100, color='xkcd:purple', width=barWidth, edgecolor=
'white', label='embedding size = 100')
    plt.bar(r2, bar_emsize200, color='xkcd:cyan', width=barWidth, edgecolor='w
hite', label='embedding size = 200')
    plt.bar(r3, bar_emsize300, color='xkcd:marigold', width=barWidth, edgecolo
r='white', label='embedding size = 300')

    # show ppl values as text
    for i in range(len(dropout_probs)):
        plt.text(r1[i] - 0.15, bar_emsize100[i] + 10, f"{bar_emsize100[i]:0.0
f}", fontsize=10)
        plt.text(r2[i] - 0.15, bar_emsize200[i] + 10, f"{bar_emsize200[i]:0.0
f}", fontsize=10)
        plt.text(r3[i] - 0.15, bar_emsize300[i] + 10, f"{bar_emsize300[i]:0.0
f}", fontsize=10)

    # lowest ppl in red colour
    plt.text(r3[1] - 0.15, bar_emsize300[1] + 10, f"{bar_emsize300[1]:0.0f}",
fontsize=10, color='r', weight='bold')

    # Add xticks on the middle of the group bars
    plt.xlabel('dropout probability')
    plt.xticks([r + barWidth for r in range(len(bar_emsize100))], dropout_prob
s)
    plt.ylabel('minimum val perplexity')
    plt.title('Results of Different Hyperparameters', fontsize=14, fontweight=
'bold')
    plt.legend()
    plt.show()
```

In [170]:
```
multibar(dropout_probs=[0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8])
```



From the Above, We Find that the Minimum Validation Perplexity is Obtained With the LSTM Model Having Embedding Size 300, Hidden Size 300 and Dropout 0.3

In [171]:
```
# find test loss and test ppl from log file for best model
with open('logs/lstm_emsize300_dropout0.3_tied.txt', 'r', encoding='utf-8') as
f:
        for line in f:
            line = line.strip()
            if line.startswith('| End of training'):
                segments = line.split('|')
                test_loss, test_ppl = segments[-2].split()[-1], segments[-1].s
plit()[-1]

# plot
plt.figure(figsize=(10, 1), dpi=160)
plt.text(0.0, 0.5, f"LSTM Model Embdedding Size 300, Hidden Size 300, Dropout
 0.3",
         fontweight='bold', fontsize=14)
# plt.axis('off')
# plt.show()

#  # plot
# plt.figure(figsize=(10, 1), dpi=160)
plt.text(0.25, 0, f"test loss: {test_loss}, test perplexity: {test_ppl}", font
weight='bold', fontsize=12, color='xkcd:red')
plt.axis('off')
plt.show()
```

LSTM Model Embdedding Size 300, Hidden Size 300, Dropout 0.3

test loss: 4.58, test perplexity: 97.63

In [ ]: