Training and updating models

ADVANCED NLP WITH SPACY



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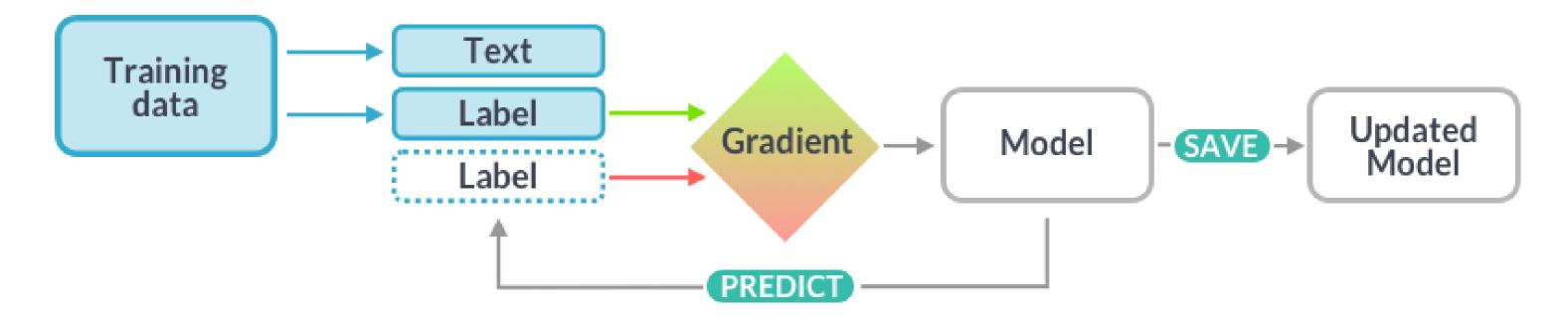
Why updating the model?

- Better results on your specific domain
- Learn classification schemes specifically for your problem
- Essential for text classification
- Very useful for named entity recognition
- Less critical for part-of-speech tagging and dependency parsing

How training works (1)

- 1. Initialize the model weights randomly with nlp.begin_training
- 2. **Predict** a few examples with the current weights by calling nlp.update
- 3. **Compare** prediction with true labels
- 4. Calculate how to change weights to improve predictions
- 5. **Update** weights slightly
- 6. Go back to 2.

How training works (2)



- Training data: Examples and their annotations.
- **Text:** The input text the model should predict a label for.
- Label: The label the model should predict.
- **Gradient:** How to change the weights.

Example: Training the entity recognizer

- The entity recognizer tags words and phrases in context
- Each token can only be part of one entity
- Examples need to come with context

```
("iPhone X is coming", {'entities': [(0, 8, 'GADGET')]})
```

Texts with no entities are also important

```
("I need a new phone! Any tips?", {'entities': []})
```

• Goal: teach the model to generalize

The training data

- Examples of what we want the model to predict in context
- Update an existing model: a few hundred to a few thousand examples
- Train a **new category**: a few thousand to a million examples
 - spaCy's English models: 2 million words
- Usually created manually by human annotators
- Can be semi-automated for example, using spaCy's Matcher!

Let's practice!

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The training loop

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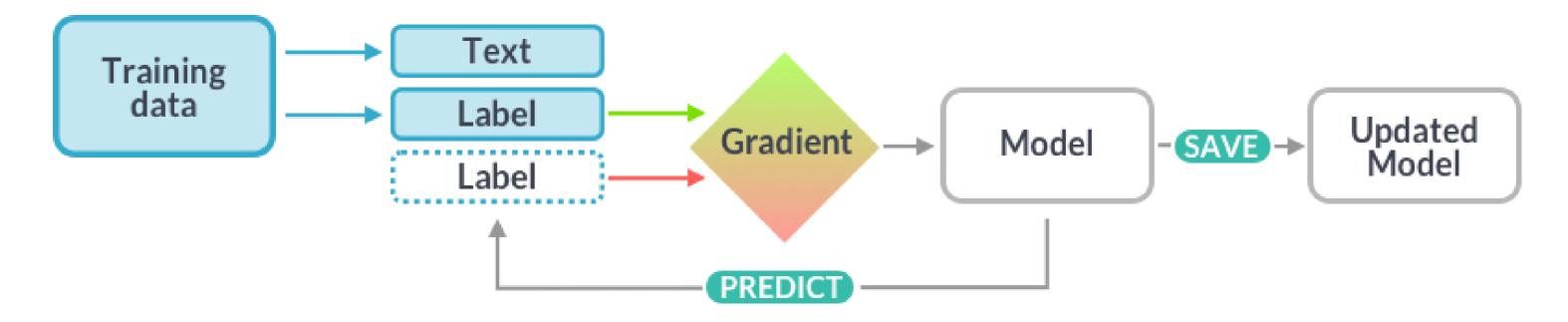
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The steps of a training loop

- 1. Loop for a number of times.
- 2. **Shuffle** the training data.
- 3. Divide the data into batches.
- 4. **Update** the model for each batch.
- 5. Save the updated model.

Recap: How training works



- Training data: Examples and their annotations.
- **Text:** The input text the model should predict a label for.
- Label: The label the model should predict.
- **Gradient:** How to change the weights.

Example loop

```
TRAINING_DATA = [
    ("How to preorder the iPhone X", {'entities': [(20, 28, 'GADGET')]})
    # And many more examples...
]
```

```
# Loop for 10 iterations
for i in range(10):
    # Shuffle the training data
    random.shuffle(TRAINING_DATA)
   # Create batches and iterate over them
    for batch in spacy.util.minibatch(TRAINING_DATA):
        # Split the batch in texts and annotations
        texts = [text for text, annotation in batch]
        annotations = [annotation for text, annotation in batch]
       # Update the model
        nlp.update(texts, annotations)
# Save the model
nlp.to_disk(path_to_model)
```

Updating an existing model

- Improve the predictions on new data
- Especially useful to improve existing categories, like PERSON
- Also possible to add new categories
- Be careful and make sure the model doesn't "forget" the old ones

Setting up a new pipeline from scratch

```
# Start with blank English model
nlp = spacy.blank('en')
# Create blank entity recognizer and add it to the pipeline
ner = nlp.create_pipe('ner')
nlp.add_pipe(ner)
# Add a new label
ner.add_label('GADGET')
# Start the training
nlp.begin_training()
# Train for 10 iterations
for itn in range(10):
    random.shuffle(examples)
    # Divide examples into batches
    for batch in spacy.util.minibatch(examples, size=2):
        texts = [text for text, annotation in batch]
        annotations = [annotation for text, annotation in batch]
        # Update the model
        nlp.update(texts, annotations)
```

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Best practices for training spaCy models

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Problem 1: Models can "forget" things

- Existing model can overfit on new data
 - e.g.: if you only update it with WEBSITE , it can "unlearn" what a PERSON is
- Also known as "catastrophic forgetting" problem

Solution 1: Mix in previously correct predictions

- For example, if you're training WEBSITE, also include examples of PERSON
- Run existing spaCy model over data and extract all other relevant entities

BAD:

```
TRAINING_DATA = [
    ('Reddit is a website', {'entities': [(0, 6, 'WEBSITE')]})
]
```

GOOD:

```
TRAINING_DATA = [
    ('Reddit is a website', {'entities': [(0, 6, 'WEBSITE')]}),
    ('Obama is a person', {'entities': [(0, 5, 'PERSON')]})
]
```

Problem 2: Models can't learn everything

- spaCy's models make predictions based on local context
- Model can struggle to learn if decision is difficult to make based on context
- Label scheme needs to be consistent and not too specific
 - For example: CLOTHING is better than ADULT_CLOTHING and CHILDRENS_CLOTHING

Solution 2: Plan your label scheme carefully

- Pick categories that are reflected in local context
- More generic is better than too specific
- Use rules to go from generic labels to specific categories

BAD:

```
LABELS = ['ADULT_SHOES', 'CHILDRENS_SHOES', 'BANDS_I_LIKE']
```

GOOD:

```
LABELS = ['CLOTHING', 'BAND']
```

Let's practice!

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Wrapping up

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Your new spaCy skills

- Extract linguistic features: part-of-speech tags, dependencies, named entities
- Work with pre-trained statistical models
- Find words and phrases using Matcher and PhraseMatcher match rules
- Best practices for working with data structures Doc , Token Span , Vocab , Lexeme
- Find semantic similarities using word vectors
- Write custom pipeline components with extension attributes
- Scale up your spaCy pipelines and make them fast
- Create training data for spaCy' statistical models
- Train and update spaCy's neural network models with new data

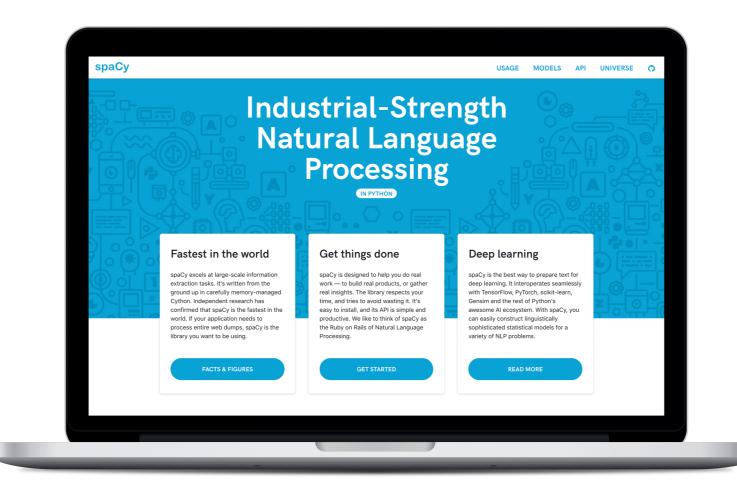
More things to do with spaCy (1)

- Training and updating other pipeline components
 - Part-of-speech tagger
 - Dependency parser
 - Text classifier

More things to do with spaCy (2)

- Customizing the tokenizer
 - Adding rules and exceptions to split text differently
- Adding or improving support for other languages
 - 45+ languages currently
 - Lots of room for improvement and more languages
 - Allows training models for other languages

See the website for more info and documentation!



spacy.io

Thanks and see you soon!

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