Implementing Mitchell's Candidate Elimination Algorithm

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Abstract

This report

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Chapter 1

Training

1.1 Recognising SOFT

The starting version spaces is:

```
S: { astigmatic: null,      tear_prod: null,      age: null,      prescription: null      }
G: { astigmatic: undefined, tear_prod: undefined, age: undefined, prescription: undefined }
```

The first example is a negative example and is covered by *G*. This causes *G* to be made more specific to ensure the case is no longer covered:

```
Example: {:astigmatic=>:no, :tear_prod=>:reduced, :age=>:young, :prescription=>:myope} ==> none
Prior Classification: unknown
After Classification: negative
-----
S: { astigmatic: null,      tear_prod: null,      age: null,      prescription: null      }
G:
  { astigmatic: yes,       tear_prod: undefined, age: undefined, prescription: undefined }
  { astigmatic: undefined, tear_prod: normal,    age: undefined, prescription: undefined }
  { astigmatic: undefined, tear_prod: undefined, age: middle,    prescription: undefined }
  { astigmatic: undefined, tear_prod: undefined, age: old,       prescription: undefined }
  { astigmatic: undefined, tear_prod: undefined, age: undefined, prescription: hyper     }
```

The next example is positive and is not covered by *S*. This causes *S* to be made more general to include the example and *G* to have all hypotheses that do not cover the new *S* to be removed:

```
Example: {:astigmatic=>:no, :tear_prod=>:normal, :age=>:young, :prescription=>:myope} ==> soft
Prior Classification: unknown
After Classification: positive
-----
S: { astigmatic: no,        tear_prod: normal,    age: young,     prescription: myope     }
G: { astigmatic: undefined, tear_prod: normal,    age: undefined, prescription: undefined }
```

The next example is negative and is consistent with *G* so the version space does not change:

```
Example: {:astigmatic=>:yes, :tear_prod=>:reduced, :age=>:young, :prescription=>:myope} ==> none
Prior Classification: negative
After Classification: negative
-----
S: { astigmatic: no,        tear_prod: normal,    age: young,     prescription: myope     }
G: { astigmatic: undefined, tear_prod: normal,    age: undefined, prescription: undefined }
```

The next example is negative and is inconsistent with *G*. This causes *G* to again be made more specific to not cover the example:

```
Example: {:astigmatic=>:yes, :tear_prod=>:normal, :age=>:young, :prescription=>:myope} ==> hard
Prior Classification: unknown
After Classification: negative
-----
S: { astigmatic: no,        tear_prod: normal,    age: young,     prescription: myope     }
G:
  { astigmatic: no,        tear_prod: normal,    age: undefined, prescription: undefined }
  { astigmatic: undefined, tear_prod: normal,    age: middle,    prescription: undefined }
  { astigmatic: undefined, tear_prod: normal,    age: old,       prescription: undefined }
  { astigmatic: undefined, tear_prod: normal,    age: undefined, prescription: hyper     }
```

The next example is negative and consistent with *G* so nothing changes:

```
Example: {:astigmatic=>:no, :tear_prod=>:reduced, :age=>:young, :prescription=>:hyper} ==> none
Prior Classification: negative
After Classification: negative
-----
S: { astigmatic: no,        tear_prod: normal,    age: young,      prescription: myope      }
G:
   { astigmatic: no,        tear_prod: normal,    age: undefined,  prescription: undefined  }
   { astigmatic: undefined, tear_prod: normal,    age: middle,     prescription: undefined  }
   { astigmatic: undefined, tear_prod: normal,    age: old,        prescription: undefined  }
   { astigmatic: undefined, tear_prod: normal,    age: undefined,  prescription: hyper      }
```

The next example is positive and not covered by *S* so *S* is made more general and the inconsistent hypotheses in *G* are removed:

```
Example: {:astigmatic=>:no, :tear_prod=>:normal, :age=>:young, :prescription=>:hyper} ==> soft
Prior Classification: unknown
After Classification: positive
-----
S: { astigmatic: no,        tear_prod: normal,    age: young,      prescription: undefined  }
G:
   { astigmatic: no,        tear_prod: normal,    age: undefined,  prescription: undefined  }
   { astigmatic: undefined, tear_prod: normal,    age: undefined,  prescription: hyper      }
```

The next example is negative and consistent with *G* so nothing changes:

```
Example: {:astigmatic=>:yes, :tear_prod=>:reduced, :age=>:young, :prescription=>:hyper} ==> none
Prior Classification: negative
After Classification: negative
-----
S: { astigmatic: no,        tear_prod: normal,    age: young,      prescription: undefined  }
G:
   { astigmatic: no,        tear_prod: normal,    age: undefined,  prescription: undefined  }
   { astigmatic: undefined, tear_prod: normal,    age: undefined,  prescription: hyper      }
```

The next example is negative and inconsistent with *G* so *G* is made more specific:

```
Example: {:astigmatic=>:yes, :tear_prod=>:normal, :age=>:young, :prescription=>:hyper} ==> hard
Prior Classification: unknown
After Classification: negative
-----
S: { astigmatic: no,        tear_prod: normal,    age: young,      prescription: undefined  }
G:
   { astigmatic: no,        tear_prod: normal,    age: undefined,  prescription: undefined  }
   { astigmatic: undefined, tear_prod: normal,    age: middle,     prescription: hyper      }
   { astigmatic: undefined, tear_prod: normal,    age: old,        prescription: hyper      }
```

The next example is negative and consistent with *G* so the version space stays the same:

```
Example: {:astigmatic=>:no, :tear_prod=>:reduced, :age=>:middle, :prescription=>:myope} ==> none
Prior Classification: negative
After Classification: negative
-----
S: { astigmatic: no,        tear_prod: normal,    age: young,      prescription: undefined  }
G:
   { astigmatic: no,        tear_prod: normal,    age: undefined,  prescription: undefined  }
   { astigmatic: undefined, tear_prod: normal,    age: middle,     prescription: hyper      }
   { astigmatic: undefined, tear_prod: normal,    age: old,        prescription: hyper      }
```

The next example is positive and not covered by *S* so *S* is generalised and inconsistent hypotheses from *G* are removed. After this *S* and *G* only contain the same hypothesis so this version space has converged. Assuming the examples are consistent then neither *S* nor *G* will change from now on:

```
Example: {:astigmatic=>:no, :tear_prod=>:normal, :age=>:middle, :prescription=>:myope} ==> soft
Prior Classification: unknown
After Classification: positive
-----
S: { astigmatic: no,        tear_prod: normal,    age: undefined,  prescription: undefined  }
G: { astigmatic: no,        tear_prod: normal,    age: undefined,  prescription: undefined  }

Example: {:astigmatic=>:yes, :tear_prod=>:reduced, :age=>:middle, :prescription=>:myope} ==> none
Prior Classification: negative
After Classification: negative
```

```
-----
S: { astigmatic: no,        tear_prod: normal,     age: undefined, prescription: undefined  }
G: { astigmatic: no,        tear_prod: normal,     age: undefined, prescription: undefined  }

Example: {:astigmatic=>:yes, :tear_prod=>:normal, :age=>:middle, :prescription=>:myope} ==> hard
 Prior Classification: negative
 After Classification: negative
-----
S: { astigmatic: no,        tear_prod: normal,     age: undefined, prescription: undefined  }
G: { astigmatic: no,        tear_prod: normal,     age: undefined, prescription: undefined  }

Example: {:astigmatic=>:no, :tear_prod=>:reduced, :age=>:middle, :prescription=>:hyper} ==> none
 Prior Classification: negative
 After Classification: negative
-----
S: { astigmatic: no,        tear_prod: normal,     age: undefined, prescription: undefined  }
G: { astigmatic: no,        tear_prod: normal,     age: undefined, prescription: undefined  }

Example: {:astigmatic=>:no, :tear_prod=>:normal, :age=>:middle, :prescription=>:hyper} ==> soft
 Prior Classification: positive
 After Classification: positive
-----
S: { astigmatic: no,        tear_prod: normal,     age: undefined, prescription: undefined  }
G: { astigmatic: no,        tear_prod: normal,     age: undefined, prescription: undefined  }

Example: {:astigmatic=>:yes, :tear_prod=>:reduced, :age=>:middle, :prescription=>:hyper} ==> none
 Prior Classification: negative
 After Classification: negative
-----
S: { astigmatic: no,        tear_prod: normal,     age: undefined, prescription: undefined  }
G: { astigmatic: no,        tear_prod: normal,     age: undefined, prescription: undefined  }

Example: {:astigmatic=>:yes, :tear_prod=>:normal, :age=>:middle, :prescription=>:hyper} ==> none
 Prior Classification: negative
 After Classification: negative
-----
S: { astigmatic: no,        tear_prod: normal,     age: undefined, prescription: undefined  }
G: { astigmatic: no,        tear_prod: normal,     age: undefined, prescription: undefined  }

Example: {:astigmatic=>:no, :tear_prod=>:reduced, :age=>:old, :prescription=>:myope} ==> none
 Prior Classification: negative
 After Classification: negative
-----
S: { astigmatic: no,        tear_prod: normal,     age: undefined, prescription: undefined  }
G: { astigmatic: no,        tear_prod: normal,     age: undefined, prescription: undefined  }

Example: {:astigmatic=>:yes, :tear_prod=>:reduced, :age=>:old, :prescription=>:myope} ==> none
 Prior Classification: negative
 After Classification: negative
-----
S: { astigmatic: no,        tear_prod: normal,     age: undefined, prescription: undefined  }
G: { astigmatic: no,        tear_prod: normal,     age: undefined, prescription: undefined  }

Example: {:astigmatic=>:yes, :tear_prod=>:normal, :age=>:old, :prescription=>:myope} ==> hard
 Prior Classification: negative
 After Classification: negative
-----
S: { astigmatic: no,        tear_prod: normal,     age: undefined, prescription: undefined  }
G: { astigmatic: no,        tear_prod: normal,     age: undefined, prescription: undefined  }

Example: {:astigmatic=>:no, :tear_prod=>:reduced, :age=>:old, :prescription=>:hyper} ==> none
 Prior Classification: negative
 After Classification: negative
-----
S: { astigmatic: no,        tear_prod: normal,     age: undefined, prescription: undefined  }
G: { astigmatic: no,        tear_prod: normal,     age: undefined, prescription: undefined  }

Example: {:astigmatic=>:no, :tear_prod=>:normal, :age=>:old, :prescription=>:hyper} ==> soft
 Prior Classification: positive
 After Classification: positive
-----
S: { astigmatic: no,        tear_prod: normal,     age: undefined, prescription: undefined  }
G: { astigmatic: no,        tear_prod: normal,     age: undefined, prescription: undefined  }
```

```
Example: {:astigmatic=>:yes, :tear_prod=>:reduced, :age=>:old, :prescription=>:hyper} ==> none
Prior Classification: negative
After Classification: negative
-----
S: { astigmatic: no,      tear_prod: normal,    age: undefined, prescription: undefined  }
G: { astigmatic: no,      tear_prod: normal,    age: undefined, prescription: undefined  }

Example: {:astigmatic=>:yes, :tear_prod=>:normal, :age=>:old, :prescription=>:hyper} ==> none
Prior Classification: negative
After Classification: negative
-----
S: { astigmatic: no,      tear_prod: normal,    age: undefined, prescription: undefined  }
G: { astigmatic: no,      tear_prod: normal,    age: undefined, prescription: undefined  }
```

Chapter 2

Classifying