Practice of Answer Set Programming

Aggregates

Ira A. Fulton Schools of Engineering
Arizona State University

Objectives

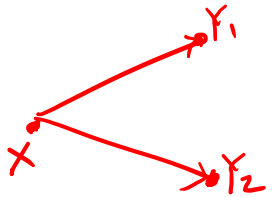
Objective

Use advanced constructs of aggregates in ASP for representing various knowledge.

Introduction

Aggregates: Counting

An aggregate is a function that can be applied to sets, such as #count, #sum, #min, #max




```
#count{Y: edge(X,Y)}.
```

```
outdegree(X,N) :- vertex(X), N = #count{Y: edge(X,Y)}.
branching_vertex(X) :- vertex(X), #count{Y: edge(X,Y)} > 1.
```

```
#count{X,Y: edge(X,Y)}
```

```
num_edges(N) :- N = #count{X,Y: edge(X,Y)}.
```


```
#count{X,Y,Z: edge(X,Y),edge(Y,Z)}
```

```
num_length2_path(N) :- N = #count{X,Y,Z: edge(X,Y),edge(Y,Z)}.
```

Aggregates : Counting, cont'd

The part of an aggregate expression to the left of the colon may include not only variables, but also more complex terms.

What is the value when n=5, 10?

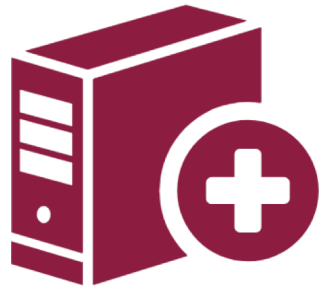
P(N):-

```
#count{X*Y: X = 2..n, Y = 2..n, X*Y <= n} = N
```

n=5 : 2*2 =4 }p(1){

n=10 : 2*2 2*3 2*4 2*5 3*3

#count} 2 6 8 10 9 { = 5 }p(5){



caculates the number of composite numbers between 1 and n

Cardinality Constraints and Aggregates

```
n {in(X): vertex(X)} n.
```
(or equivalently, `{in(X): vertex(X)}=n.`

can be also rewritten with a choice rule and a constraint:

```
{in(X)} :- vertex(X).
:- #count{X: in(X)} != n.
```

Exercise. Find a similar transformation for the rule

```
5{p(X): q(X)}7.
```

```
{p(X)} :- q(X).
:- #count{X: p(X)} < 5.
:- #count{X: p(X)} > 7.
```

Exercise

```
p(a,1).   p(b,1).   p(b,2).    p(c,2).
q(N) :- N = #count{A,X : p(A,X)}.
r(N) :- N = #count{A : p(A,X)}.
s(N) :- N = #count{X : p(A,X)}.
```

What is its stable model?

{ p(a,1), p(b,1), p(b,2), p(c,2)

q(4)

r(3)

s(2) }

Summation

- If #sum is applied to an expression containing several terms to the left of the colon then the value of #sum can be described in terms of "weights."
- The weight of a tuple consisting of integers and symbolic constants is the first member of the tuple.
- What #sum calculates in application to a set of tuples is the sum of the weights of all its elements that have integer weights.

```
p(1,10; 2,20).
q(S) :- S = #sum{X,Y : p(X,Y)}.
r(S) :- S = #sum{Y,X : p(X,Y)}.
```

(X, Y) = (1, 10), (2, 20)

q(30)

r(30)

(Y, X) = (10, 1), (20, 2)

Exercise

What is the stable model of the program

```
p(S) :- S = #sum{N*N, N : N=-2..2}.
q(S) :- S = #sum{N*N : N=-2..2}.
```

P(10)

{(4,-2), (1,-1), (0,0), (1,1), (4,2)}

{4, 1, 0}

q(5)

Wrap-Up