

Introduction to Databases

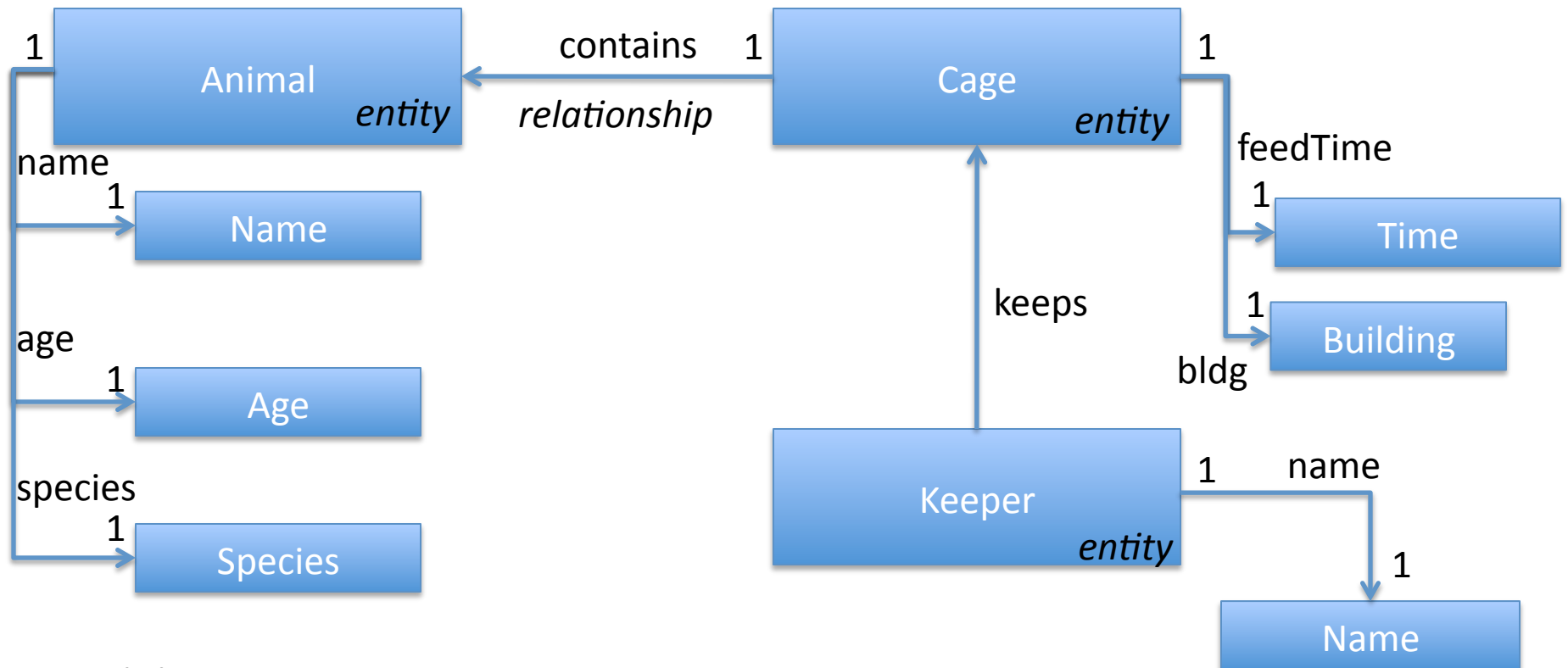
CS162 Guest Lecture

Sam Madden

madden@csail.mit.edu

Zoo Data Model

Entity Relationship Diagram



Animals have names, ages, species

Keepers have names

Cages have cleaning times, buildings

Animals are in 1 cage; cages have multiple animals

Keepers keep multiple cages, cages kept by multiple keepers

Our Zoo



Sam the Salamander

Slimy



Stoica the Shrew

Skinny
Energetic



Sally the Student

SQL – Structured Query Language

```
SELECT field1, ..., fieldM  
FROM table1, ...  
WHERE condition1, ...
```

```
INSERT INTO table VALUES (field1, ...)
```

```
UPDATE table SET field1 = X, ...  
WHERE condition1,...
```

Names of Shrews

- Imperative

```
for each row r in animals
  if r.species = 'shrew'
    output r.name
```

- Declarative

```
SELECT r.name FROM animals
WHERE r.species = 'shrew'
```

Cages in VLSB

- Imperative

```
for each row a in animals
  for each row c in cages
    if a.cageno = c.no and c.bldg = VLSB
      output a
```

- Declarative

```
SELECT a.name FROM animals AS a, cages AS c
WHERE a.cageno = c.no AND c.bldg = VLSB
```

Average Age of Bears

- Declarative

```
SELECT AVG(age) FROM animals  
WHERE species = 'bear'
```

Complex Queries

Find pairs of animals of the same species and different genders older than 1 year:

```
SELECT a1.name,a2.name  
FROM animals as a1, animals as a2  
WHERE a1.gender = M and a2.gender = F  
AND a1.species = a2.species  
AND a1.age > 1 and a2.age > 1
```

“self join”

Find cages with shrews fed later than the average feedtime of any cage:

```
SELECT cages.cageid FROM cages, animals  
WHERE animals.species = 'shrew'  
AND animals.cageid = cages.cageid  
AND cages.feedtime >  
    (SELECT AVG(feedtime) FROM cages )
```

“nested queries”

Complex Queries 2

Find keepers who keep both shrews and salamanders:

```
SELECT keeper.name
```

```
FROM keeper, cages as c1, cages as c2,
```

```
    keeps as k1, keeps as k2, animals as a1, animals as a2
```

```
WHERE c1.cageid = k1.cageid AND keeper.keeperid = k1.keeperid
```

```
AND c2.cageid = k2.cageid AND keeper.keeperid = k2.keeperid
```

```
AND a1.species = 'shrew' AND a2.species = 'salamander'
```

```
AND c1.cageid = a1.cageid AND c2.cageid = a2.cageid
```

