RESOURCE DESCRIPTION FRAMEWORK (RDF)

18

18

Example I: Tabular Data

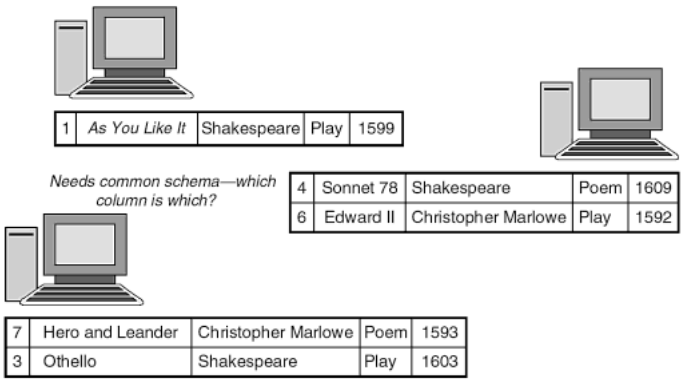
Table 3-1 Tabular Data about Elizabethan Literature and Music

ID	Title	Author	Medium	Year
1	*As You Like It*	Shakespeare	Play	1599
2	*Hamlet*	Shakespeare	Play	1604
3	*Othello*	Shakespeare	Play	1603
4	"Sonnet 78"	Shakespeare	Poem	1609
5	*Astrophil and Stella*	Sir Phillip Sidney	Poem	1590
6	*Edward II*	Christopher Marlowe	Play	1592
7	*Hero and Leander*	Christopher Marlowe	Poem	1593
8	*Greensleeves*	Henry VIII Rex	Song	1525

19

19

Distribute Data by Row



1	*As You Like It*	Shakespeare	Play	1599

Needs common schema—which column is which?

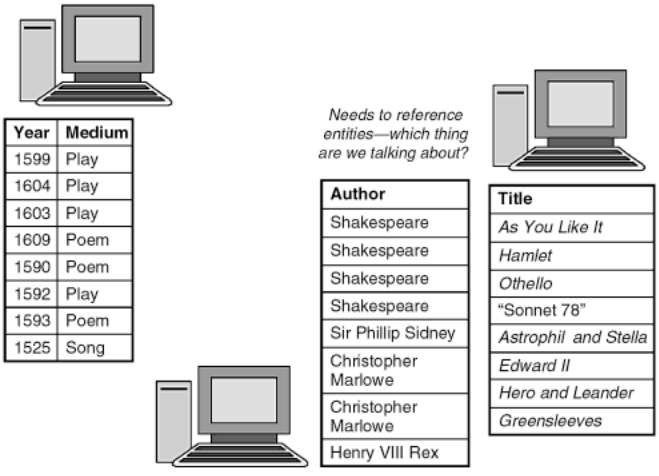
4	Sonnet 78	Shakespeare	Poem	1609
6	Edward II	Christopher Marlowe	Play	1592

7	Hero and Leander	Christopher Marlowe	Poem	1593
3	Othello	Shakespeare	Play	1603

20

20

Distribute Data by Column



Year	Medium
1599	Play
1604	Play
1603	Play
1609	Poem
1590	Poem
1592	Play
1593	Poem
1525	Song

Needs to reference entities—which thing are we talking about?

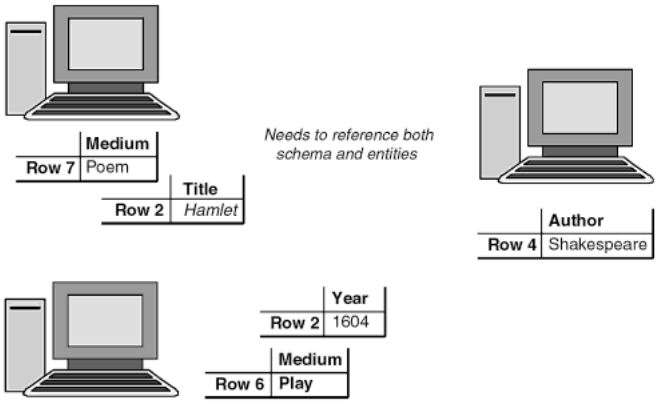
Author
Shakespeare
Shakespeare
Shakespeare
Shakespeare
Sir Phillip Sidney
Christopher Marlowe
Christopher Marlowe
Henry VIII Rex

Title
As You Like It
Hamlet
Othello
"Sonnet 78"
Astrophil and Stella
Edward II
Hero and Leander
Greensleeves

21

21

Distribute Data by Cell



22

22

Representation as Triples

Table 3-2 Sample Triples

Subject	Predicate	Object
Row 7	Medium	Poem
Row 2	Title	Hamlet
Row 2	Year	1604
Row 4	Author	Shakespeare
Row 6	Medium	Play

23

23

Example II

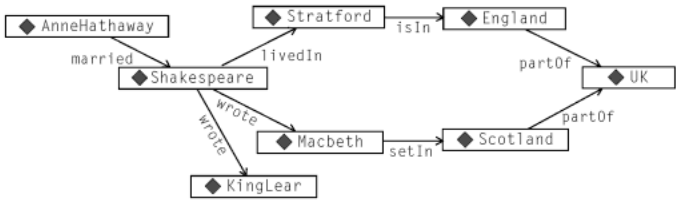
Table 3-3 Sample Triples

Subject	Predicate	Object
Shakespeare	Wrote	King Lear
Shakespeare	Wrote	Macbeth
Anne Hathaway	Married	Shakespeare
Shakespeare	Lived In	Stratford
Stratford	Is in	England
Macbeth	Set in	Scotland
England	Part of	The UK
Scotland	Part of	The UK

24

24

Graphical Representation



25

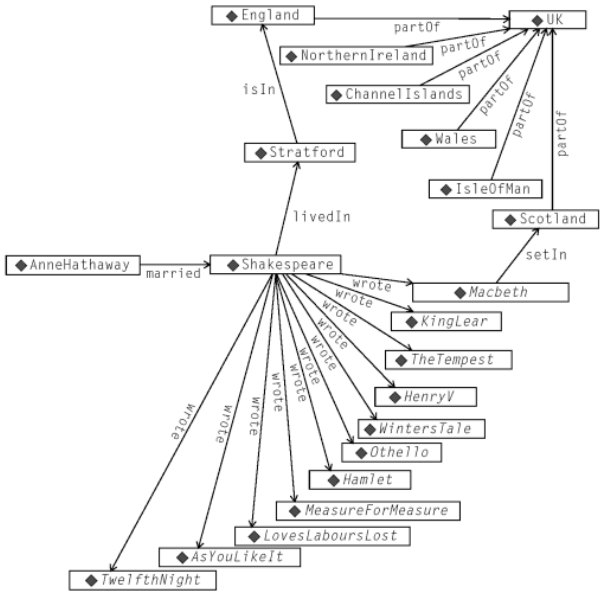
25

Example III

Table 3-4 Triples about Shakespeare's Plays

Subject	Predicate	Object
Shakespeare	Wrote	*As You Like It*
Shakespeare	Wrote	*Henry V*
Shakespeare	Wrote	*Love's Labours Lost*
Shakespeare	Wrote	*Measure for Measure*
Shakespeare	Wrote	*Twelfth Night*
Shakespeare	Wrote	*The Winter's Tale*
Shakespeare	Wrote	*Hamlet*
Shakespeare	Wrote	*Othello*
		etc.

Merging



Basic Ideas of RDF

- Basic building block:
  subject-predicate-object triple
  - Statement
  - "Shakespeare wrote MacBeth"
- RDF has been given a syntax in XML
  - This syntax inherits the benefits of XML
  - It also inherits all the problems e.g. unreadable syntax

28

28

Basic Ideas of RDF (2)

- The fundamental concepts of RDF are:
  - resources
  - properties
  - statements

29

29

Logic: Terms

Resources

- Resource: any “thing” we want to talk about
  - E.g. authors, books, publishers, places, people, hotels
- Every resource has a URI

30

30

Logic: Predicates

Properties

- Special kind of resources
- Describe relations between resources
  - E.g. “written by”, “age”, “title”, etc.
- Properties are also identified by URIs

31

31

Logic: Formula

Statements

- Assert the properties of resources
- Subject-predicate-object triple
- Objects can be resources or **literals**
  - Literals are atomic values (strings)

Three Views of a Statement

- A triple
- A piece of a graph
- A piece of XML code

Thus an RDF document can be viewed as:

- A set of triples
- A graph (semantic net)
- An XML document

Names

- Nodes in the semantic net identified by URIs
- Qname syntax
  - Namespace qualifier, colon, identifier
  - Example: geo:England, lit:MacBeth
  - Namespace qualifier associated with URI
  - We will assume a default namespace
  - Example: :Shakespeare, :JamesDean, :Researcher

34

34

Example

Table 3-6 Plays of Shakespeare with qnames

Subject	Predicate	Object
lit:Shakespeare	lit:wrote	lit:AsYouLikeIt
lit:Shakespeare	lit:wrote	lit:HenryV
lit:Shakespeare	lit:wrote	lit:LovesLaboursLost
lit:Shakespeare	lit:wrote	lit:MeasureForMeasure
lit:Shakespeare	lit:wrote	lit:TwelfthNight
lit:Shakespeare	lit:wrote	lit:WintersTale
lit:Shakespeare	lit:wrote	lit:Hamlet
lit:Shakespeare	lit:wrote	lit:Othello
		etc.

Table 3-7 Geographical Information as qnames

Subject	Predicate	Object
geo:Scotland	geo:partOf	geo:UK
geo:England	geo:partOf	geo:UK
geo:Wales	geo:partOf	geo:UK
geo:NorthernIreland	geo:partOf	geo:UK
geo:ChannelIslands	geo:partOf	geo:UK
geo:IsleOfMan	geo:partOf	geo:UK

35

35

Example

Table 3-8 Triples Referring to URIs with a Variety of Namespaces

Subject	Predicate	Object
lit:Shakespeare	lit:wrote	lit:KingLear
lit:Shakespeare	lit:wrote	lit:MacBeth
bio:AnneHathaway	bio:married	lit:Shakespeare
bio:AnneHathaway	bio:livedWith	lit:Shakespeare
lit:Shakespeare	bio:livedIn	geo:Stratford
geo:Stratford	geo:isIn	geo:England
geo:England	geo:partOf	geo:UK
geo:Scotland	geo:partOf	geo:UK

36

36

Standard Namespaces

- **rdf:** Identifiers used in RDF
  - URI: http://www.w3.org/1999/02/22-rdf-syntax-ns#
- **rdfs:** identifiers used for the RDF Schema language
  - URI: http://www.w3.org/2000/01/rdf-schema#
- **owl:** identifiers used for the Web Ontology Language
  - URI: http://www.w3.org/2002/07/owl#

37

37

N3/Turtle Syntax

- Notation 3 RDF (N3)
  - Invented by Berners-Lee
- Example

```
@prefix lit:
<http://www.example.org/literature#>
@prefix rdf:
<http://www.w3.org/1999/02/22-rdf-syntax-ns#>
lit:Shakespeare lit:wrote lit:MacBeth .
...
```

38

38

Statements in Logic

```
lit:Shakespeare lit:wrote lit:MacBeth .
```

- The triple (x P y) can be considered as a logical formula P(x,y)
  - Binary predicate P relates subject x to object y
  - *RDF offers only binary predicates (properties)*

39

39

Representing Tabular Data in RDF (1)

Table 3-12 Sample Tabular Data for Triples

Product						
ID	**Model Number**	**Division**	**Product Line**	**Manufacture Location**	**SKU**	**Available**
1	ZX-3	Manufacturing support	Paper machine	Sacramento	FB3524	23
2	ZX-3P	Manufacturing support	Paper machine	Sacramento	KD5243	4
3	ZX-3S	Manufacturing support	Paper machine	Sacramento	IL4028	34
4	B-1430	Control Engineering	Feedback line	Elizabeth	KS4520	23
5	B-1430X	Control Engineering	Feedback line	Elizabeth	CL5934	14
6	B-1431	Control Engineering	Active sensor	Seoul	KK3945	0
7	DBB-12	Accessories	Monitor	Hong Kong	ND5520	100
8	SP-1234	Safety	Safety valve	Cleveland	HI4554	4
9	SPX-1234	Safety	Safety valve	Cleveland	OP5333	14

40

40

Representing Tabular Data in RDF (2)

- Define a URI for the database e.g. mfg:
- Define qname for each row
  - namespace, database name and database key e.g. mfg:Product1, mfg:Product2, …
- Define qname for each column
  - namespace, database name and column name e.g. mfg:Product_ModelNo
- "Objects" of triples are literal data

41

41

Representing Tabular Data in RDF (3)

Table 3-13 Triples Representing Some of the Data in Table 3-12

Subject	Predicate	Object
mfg:Product1	mfg:Product_ID	1
mfg:Product1	mfg:Product_ModelNo	ZX-3
mfg:Product1	mfg:Product_Division	Manufacturing support
mfg:Product1	mfg:Product_Product_Line	Paper machine
mfg:Product1	mfg:Product_Manufacture_Location	Sacramento
mfg:Product1	mfg:Product_SKU	FB3524
mfg:Product1	mfg:Proudct_Available	23
mfg:Product2	mfg:Product_ID	2
mfg:Product2	mfg:Product_ModelNo	ZX-3P
mfg:Product2	mfg:Product_Division	Manufacturing support
mfg:Product2	mfg:Product_Product_Line	Paper machine
mfg:Product2	mfg:Product_Manufacture_Location	Sacramento
mfg:Product2	mfg:Product_SKU	KD5243
mfg:Product2	mfg:Product_Available	4…

42

42

```
<rdf:RDF
xmlns:mfg="http://www.WorkingOntologist.com/Examples/Chap-
ter3/Manufacturing.rdf#"
   xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#">
   <mfg:Product
rdf:about="http://www.WorkingOntologist.com/Examples/Chap-
ter3/Manufacturing.rdf#Product1">
   <mfg:Available>23</mfg:Available>
   <mfg:Division>Manufacturing support</mfg:Division>
   <mfg:ProductLine>Paper machine</mfg:ProductLine>
   <mfg:SKU>FB3524</mfg:SKU>
   <mfg:ModelNo>ZX-3</mfg:ModelNo>
   <mfg:ManufactureLocation>Sacramento</mfg:Manufacture
   Location>
   </mfg:Product>
   <mfg:Product
rdf:about="http://www.WorkingOntologist.com/Examples/Chap-
ter3/Manufacturing.rdf#Product2">
   <mfg:SKU>KD5243</mfg:SKU>
   <mfg:Division>Manufacturing support</mfg:Division>
   <mfg:ManufactureLocation>Sacramento</mfg:Manufacture
   Location>
   <mfg:Available>4</mfg:Available>
   <mfg:ModelNo>ZX-3P</mfg:ModelNo>
   <mfg:ProductLine>Paper machine</mfg:ProductLine>
   </mfg:Product>
</rdf:RDF>
```

43

43

RDF Namespace

- rdf:type is a predicate relating resources to types

```
lit:Shakespeare rdf:type lit:Playwright
lit:Marlowe rdf:type lit:Playwright
lit:Playwright rdf:type bus:Profession
mfg:Product1 rdf:type mfg:Product
```

- rdf:Property is a resource for properties

```
lit:wrote rdf:type rdf:Property
bio:livedIn rdf:type rdf:Property
```

44

44

Modifying Statements

- Example: Shakespeare wrote Hamlet *in 1061*.
  - Represent additional information using additional triples about the "row."

```
bio:n1 bio:author lit:Shakespeare ;
       bio:title lit:Hamlet ;
       bio:publicationDate 1601 .
```

Row identifier

45

45

Higher Order Statements

- Example: *Wikipedia states* that Shakespeare wrote Hamlet.
  - *Reify* the statement that "Shakespeare wrote Hamlet" as a resource

```
q:n1 rdf:subject lit:Shakespeare ;
     rdf:predicate lit:wrote ;
     rdf:object lit:Hamlet .
web:Wikipedia m:says q:n1 .
```

46

46