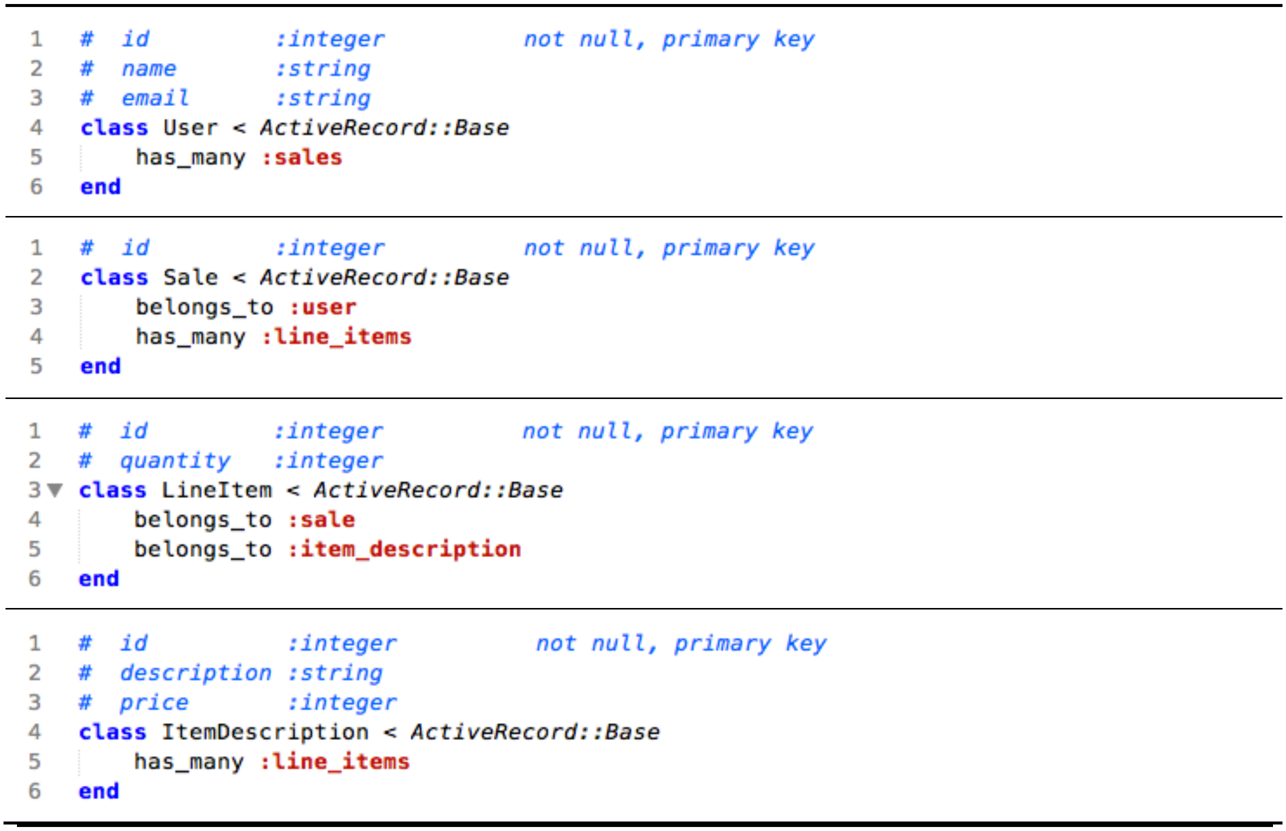
Here is a figure to consider while answering the following questions.



```ruby
#  id          :integer          not null, primary key
#  name        :string
#  email       :string
class User < ActiveRecord::Base
    has_many :sales
end
```

```ruby
#  id          :integer          not null, primary key
class Sale < ActiveRecord::Base
    belongs_to :user
    has_many :line_items
end
```

```ruby
#  id          :integer          not null, primary key
#  quantity    :integer
class LineItem < ActiveRecord::Base
    belongs_to :sale
    belongs_to :item_description
end
```

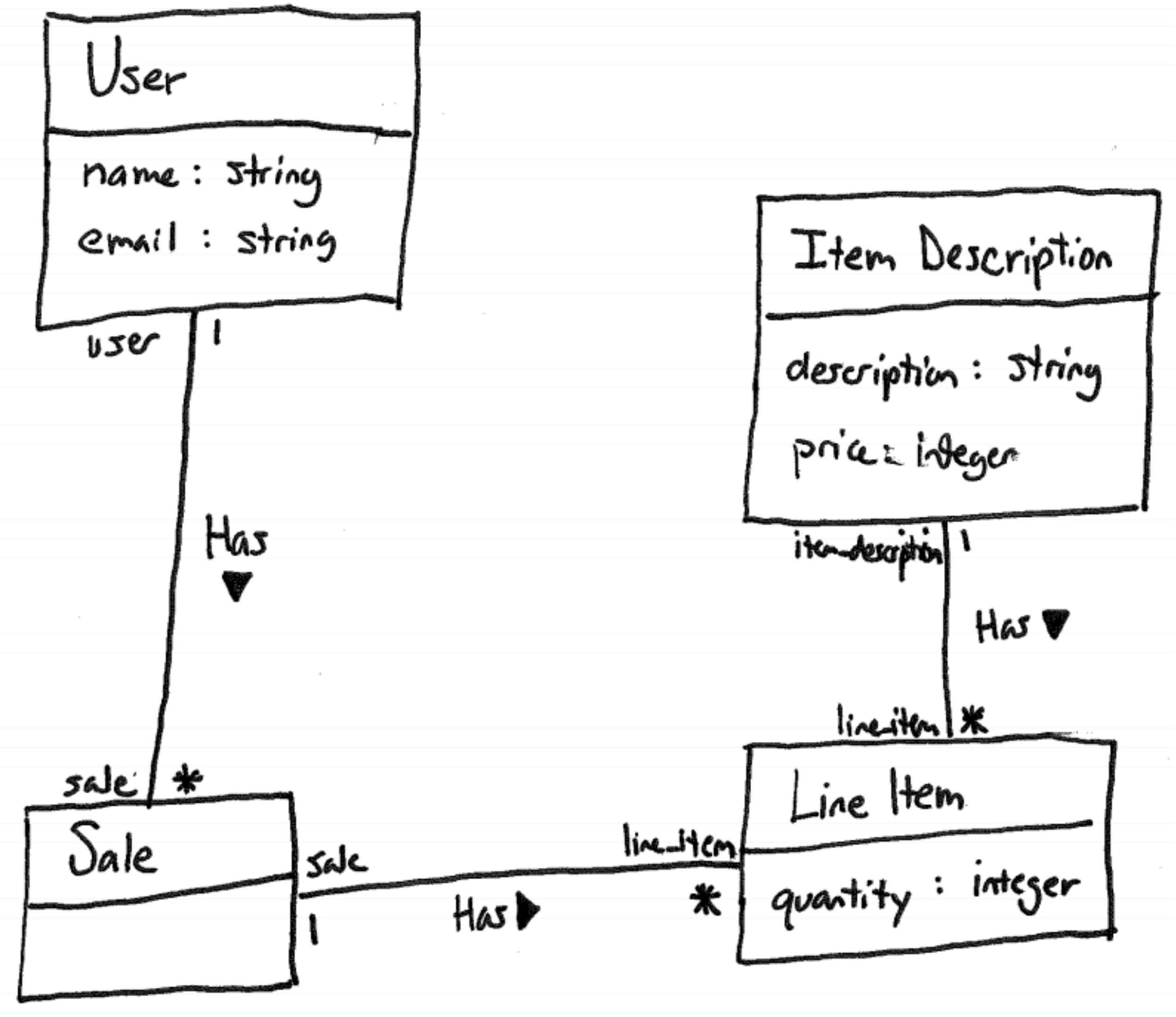
```ruby
#  id          :integer          not null, primary key
#  description :string
#  price       :integer
class ItemDescription < ActiveRecord::Base
    has_many :line_items
end
```

Figure 14. Model classes for a point-of-sale system.

Problem:

Create a UML class diagram representing the Figure 14 point-of-sale model classes. Be sure to label all associations and association ends, and include all multiplicities. Don't include "id" attributes (objects have identity by default).

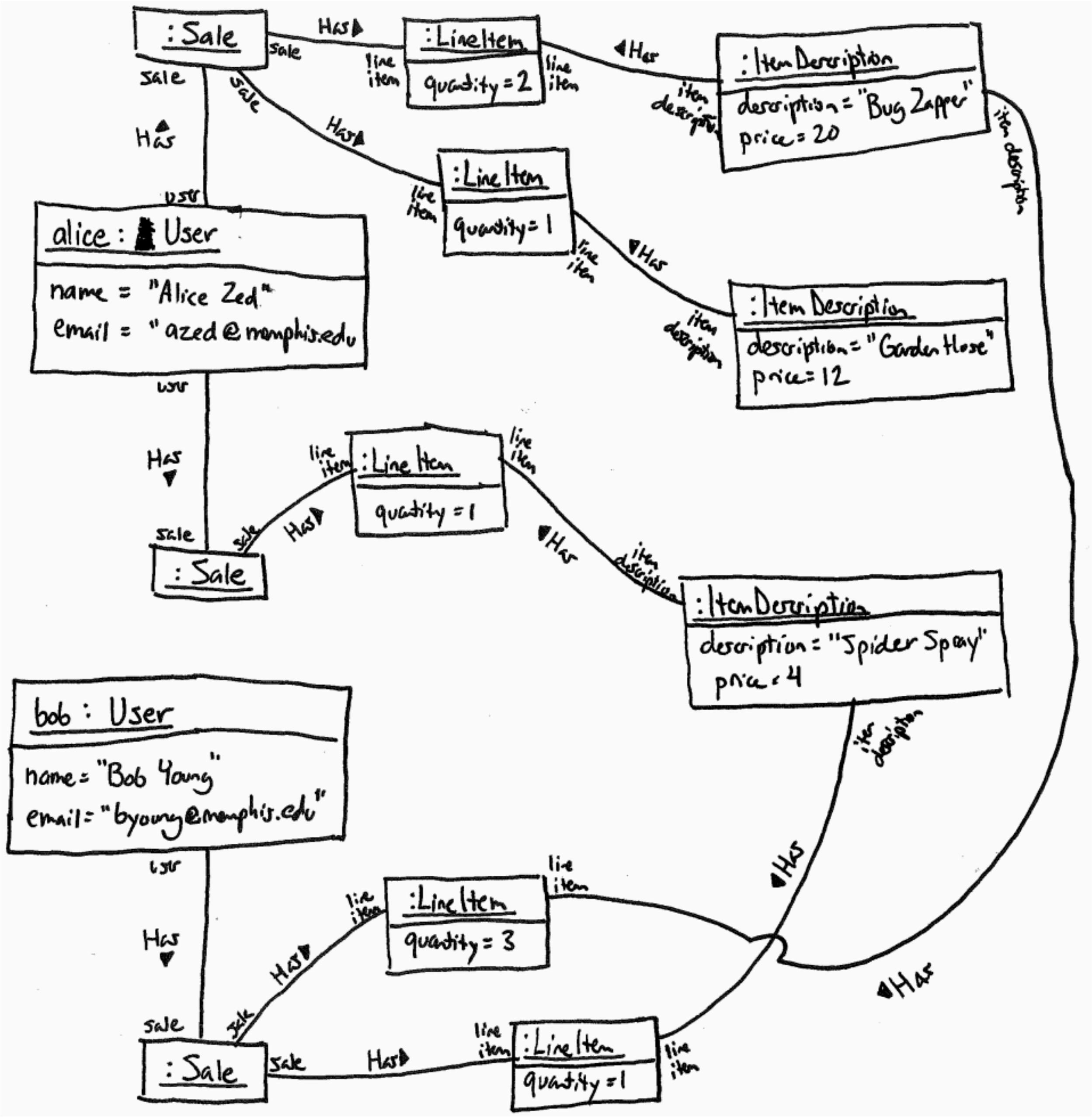
Solution:


User
name : string
email : string
user
1
Has ▼
sale
*
Sale
sale
1
Has ▶
line_item
*
Line Item
quantity : integer
line_item
*
item_description
1
Has ▼
Item Description
description : string
price : integer

Problem:

Consider the following execution of a point-of-sale system with the model in Figure 14. Two users register: Alice Zed (azed@memphis.edu) and Bob Young (byoung@memphis.edu). Alice purchases the following things: 2 Bug Zappers ($20 each) and 1 Garden Hose ($12 each). Bob purchases the following things: 3 Bug Zappers and 1 Spider Spray ($4 each). Later, Alice makes another purchase: 1 Spider Spray. Create an object diagram that depicts the model objects after this execution.

Solution:


:Sale
sale
Has ▶
line item
:LineItem
quantity = 2
line item
◀ Has
item description
:ItemDescription
description = "Bug Zapper"
price = 20
item description
sale
sale
Has ▲
Has ▲
user
line item
:LineItem
quantity = 1
line item
◀ Has
item description
:ItemDescription
description = "Garden Hose"
price = 12
alice : User
name = "Alice Zed"
email = "azed@memphis.edu
user
Has ▼
sale
sale
:Sale
Has ▶
line item
:LineItem
quantity = 1
line item
◀ Has
item description
:ItemDescription
description = "Spider Spray"
price = 4
item description
bob : User
name = "Bob Young"
email = "byoung@memphis.edu"
user
Has ▼
sale
sale
:Sale
Has ▼
line item
:LineItem
quantity = 3
line item
◀ Has
sale
Has ▶
line item
:LineItem
quantity = 1
line item
◀ Has