

The *Tikz-er2* Package for Drawing Entity-Relationship Diagrams

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Abstract

This document describes *Tikz-er2*, a L^AT_EX package for drawing Entity-Relationship diagrams. *Tikz-er2* uses Tikz/PGF for graphics and is very easy to use. In the following, you can find instructions on how to draw each individual E-R element and an example of a full E-R diagram.

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1 The *Tikz-er2* Package

Tikz-er2 is a \LaTeX package that uses the Tikz/PGF¹ library to draw Entity-Relationship diagrams. It is, in practice, a set of Tikz styles, which you can use together with your usual Tikz instructions to draw the diagrams.

Tikz already has an E-R diagram library. However, I felt it was very incomplete, lacking some of the features I usually require when designing databases. Thus, I implemented *Tikz-er2*, which uses the E-R notation described in the book “Database System Concepts”, by Silberchatz et al.²

This package, as everything else in the Tikz library, is very easy to use. In the following sections, you will find a full set of examples of how to use it to create an E-R diagram.

I should note that, although I believe these examples are enough to draw any (moderately complex) diagram, I strongly recommend reading the Tikz/PGF manual. Besides being useful if you need to draw something that I did not remember to exemplify here, you will be amazed with what Tikz/PGF can do for your \LaTeX graphics.

2 Drawing E-R Diagrams

To use the *Tikz-er2* package you should include the command

```
\usepackage{tikz-er2}
```

in the preamble of your document. This section shows how to draw each individual element in an E-R diagram. Each figure is shown together with the code used to generate it.

2.1 Entity Sets

Entity sets are represented using the `entity` style. The following code draws an entity set element. An example, with the respective \LaTeX code is shown in Figure 1.

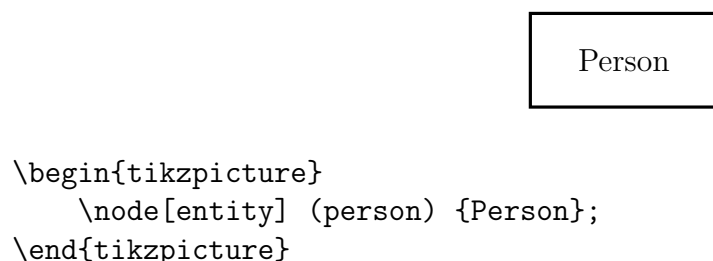


Figure 1: Entity set.

¹<http://sourceforge.net/projects/pgf/>

²Abraham Silberschatz, Henry F. Korth, and S. Sudarshan: “Database System Concepts”. 5th Edition, McGraw-Hill, 2005.

You can change the style of the elements by redefining the `every entity` style, as shown in Figure 2.



```
\tikzstyle{every entity} = [draw=blue, fill=blue!20, text=red]
\begin{tikzpicture}
  \node[entity] (person) {Person};
\end{tikzpicture}
```

Figure 2: Entity set, with a different style.

2.2 Attributes

You can draw all types of attributes, as seen in Figure 3.

Regular attributes are drawn using the `attribute` style. There is a style `multi attribute` for multi-valued attributes and a style `derived attribute` for derived attributes. Key attributes are drawn by using the command `\key` on its label, to get underlined text.

As for entity sets, you can change the style of the attributes by redefining the `every attribute` style.

2.3 Relationship Sets

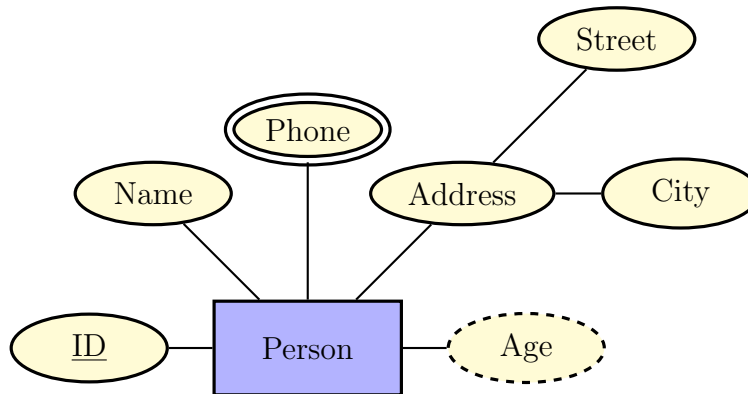
There is a `relationship` style for relationship sets. This example shows a *many-to-many* relationship. In this case, we changed the style of all relationship sets by redefining the `every relationship` style.

There is also a style for the links connecting relationship sets to entity sets (and to attribute sets): the `link` style. In Figure 4, instead of using the `link` style on every edge, we simply redefined the `every edge` style to use it.

To draw a *one-to-many* relationship, or a one to one relationship, you just need to draw an arrowhead on the respective edge. To draw a total participation you can use the style `total` on the corresponding edge. An example of both cases is shown in Figure 5.

You can also use an alternative notation, where you specify the cardinality of the relationship as a number on the links. In this case, you just need to add a label to the respective link, as seen in Figure 6.

The same method can be used to add roles to the participant entities. An example is shown in Figure 7.

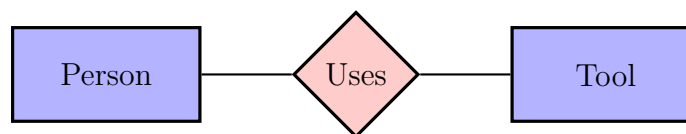


```

\tikzstyle{every attribute} = [fill=yellow!20]
\begin{tikzpicture}[node distance=7em]
  \node[entity] (person) {Person};
  \node[attribute] (pid) [left of=person] {\key{ID}} edge (person);
  \node[attribute] (name) [above left of=person] {Name} edge (person);
  \node[multi attribute] (phone) [above of=person] {Phone} edge (person);
  \node[attribute] (address) [above right of=person] {Address} edge (person);
  \node[attribute] (street) [above right of=address] {Street} edge (address);
  \node[attribute] (city) [right of=address] {City} edge (address);
  \node[derived attribute] (age) [right of=person] {Age} edge (person);
\end{tikzpicture}

```

Figure 3: Attribute.



```

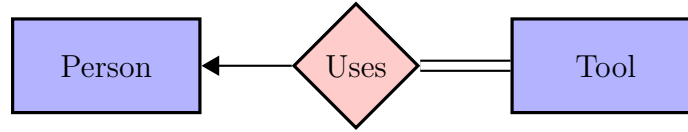
\tikzstyle{every relationship} = [fill=red!20]
\tikzstyle{every edge} = [link]
\begin{tikzpicture}[node distance=8em]
  \node[entity] (person) {Person};
  \node[relationship] (uses) [right of=person] {Uses} edge (person);
  \node[entity] (tool) [right of=uses] {Tool} edge (uses);
\end{tikzpicture}

```

Figure 4: Relationship set.

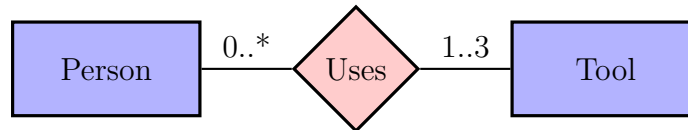
2.4 Weak Entity Sets

The style for weak entities is `weak entity`, shown in Figure 8. The identifying relationship uses style `ident relationship`. The `\discriminator` command is used to draw a dashed



```
\begin{tikzpicture}[node distance=8em]
  \node[entity] (person) {Person};
  \node[relationship] (uses) [right of=person] {Uses} edge [->] (person);
  \node[entity] (tool) [right of=uses] {Tool} edge [total] (uses);
\end{tikzpicture}
```

Figure 5: One-to-many relationship set, with a total participation.



```
\begin{tikzpicture}[node distance=8em]
  \node[entity] (person) {Person};
  \node[relationship] (uses) [right of=person] {Uses}
    edge node[auto,swap] {0..*} (person);
  \node[entity] (tool) [right of=uses] {Tool}
    edge node[auto,swap] {1..3} (uses);
\end{tikzpicture}
```

Figure 6: Alternative notation for relationship set cardinality.

underline, to represent the discriminator attribute.

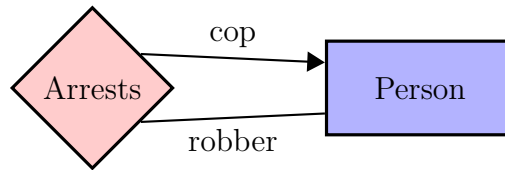
To redefine the style for all weak entities you can use the **every weak entity** style.

2.5 Specialization/Generalization

A specialization/generalization is drawn using the **isa** style, exemplified in Figure 9.

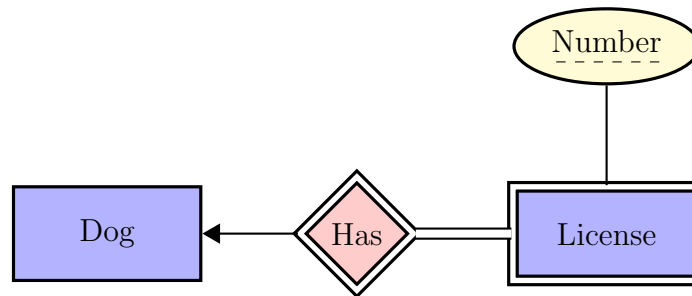
To draw a total specialization/generalization, we can use the **total** style on the corresponding link. To add constraints, such as *disjoint/overlapping*, we can add a label to the corresponding link.

As before, you can also redefine the **every isa** style, to change the appearance of all specialization/generalization symbols.



```
\begin{tikzpicture}[node distance=10.5em]
  \node[relationship] (arrests) {Arrests};
  \node[entity] (person) [right of=arrests] {Person};
  \draw (person.165) edge [<-] node[auto,swap] {cop} (arrests.35)
        (person.-165) edge node[auto] {robber} (arrests.-35);
\end{tikzpicture}
```

Figure 7: Roles in an E-R diagram.



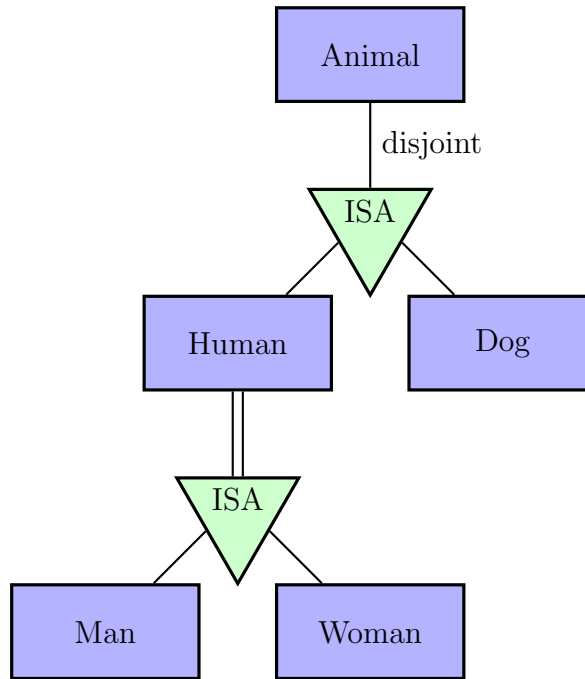
```
\begin{tikzpicture}[node distance=8em]
  \node[entity] (dog) {Dog};
  \node[ident relationship] (has) [right of=dog] {Has} edge [->] (dog);
  \node[weak entity] (license) [right of=has] {License} edge [total] (has);
  \node[attribute] (lnum) [above of=license, node distance=6em]
    {\discriminator{Number}} edge (license);
\end{tikzpicture}
```

Figure 8: Weak entity set.

2.6 Aggregation

Finally, you can draw aggregations by simply joining two relationship sets, as shown in Figure 10.

The rectangle around the aggregation can be drawn using the functionalities provided by the Tikz `fit` library, already included by the *Tikz-er2* package.



```

\tikzstyle{every isa} = [fill=green!20]
\begin{tikzpicture}[node distance=6em]
  \node[entity] (animal) {Animal};
  \node[isa] (isa1) [below of=animal, node distance=5em] {ISA}
    edge node [auto,swap] {disjoint} (animal);
  \node [entity] (human) [below left of=isa1] {Human} edge (isa1);
  \node [entity] (dog) [below right of=isa1] {Dog} edge (isa1);
  \node[isa] (isa2) [below of=human, node distance=5em] {ISA}
    edge [total] (human);
  \node [entity] (man) [below left of=isa2] {Man} edge (isa2);
  \node [entity] (woman) [below right of=isa2] {Woman} edge (isa2);
\end{tikzpicture}

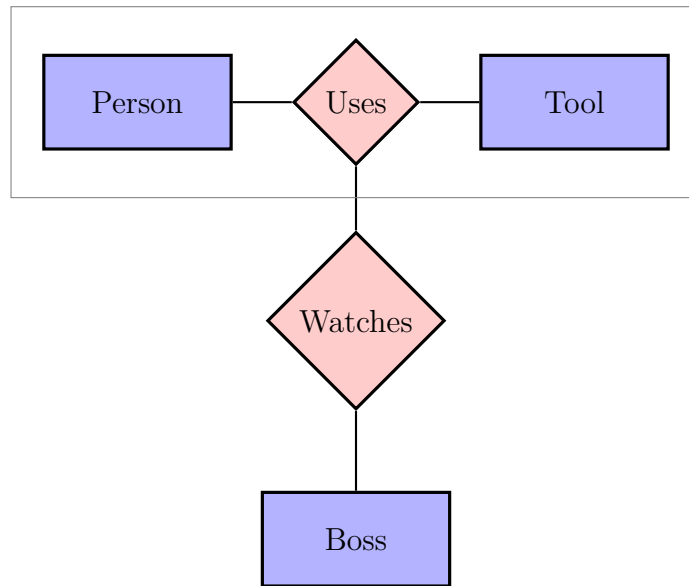
```

Figure 9: Specialization/generalization.

3 A Full Example

In Figure 11 is a an example of a simple complete E-R diagram. It represents a database for a used car store. It was used as an exercise in the databases course I teach at IST³. The code for this example can be found in Appendix A.

³<http://www.ist.utl.pt>



```

\begin{tikzpicture}[node distance=7em]
  \node[entity] (person) {Person};
  \node[relationship] (uses) [right of=person] {Uses} edge (person);
  \node[entity] (tool) [right of=uses] {Tool} edge (uses);
  \node[relationship] (watches) [below of=uses] {Watches} edge (uses);
  \node[entity] (boss) [below of=watches] {Boss} edge (watches);
  \node[rectangle, draw=gray, fit=(person) (uses) (tool), inner sep=1em] {};
\end{tikzpicture}

```

Figure 10: Aggregation.

4 Other Information

This package can be obtained at <http://www.assembla.com/spaces/tikz-er2>. You can use it free of charge for whatever you want, in whatever way you need.

The only thing I ask is that you let me know if you make any modifications to the package. If they can be useful to everyone, I'll be glad to insert them in the next version, giving the proper credit to the author, of course.

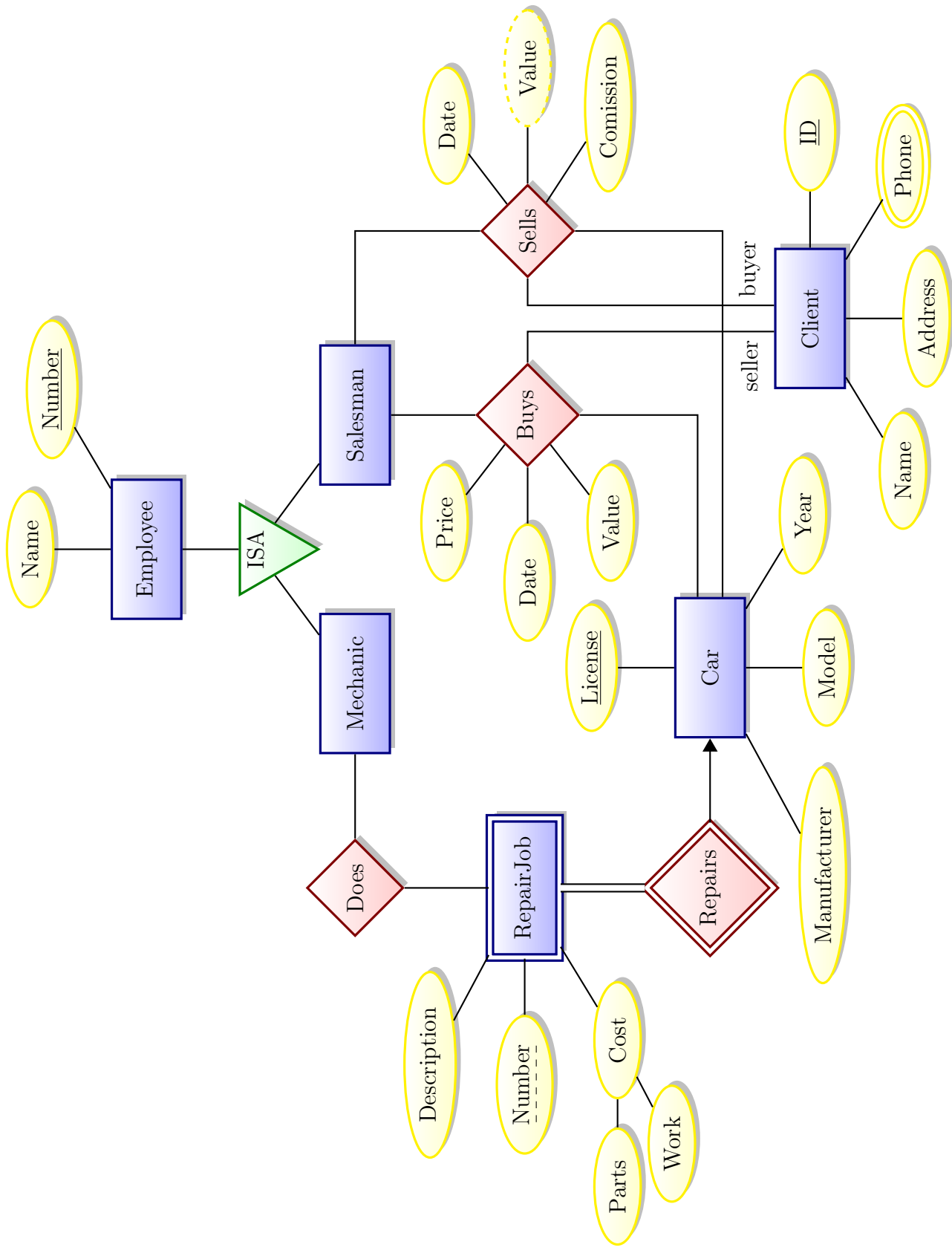


Figure 11: E-R diagram for a used car store database.

A Tikz Code for the Full Example

```
\usetikzlibrary{positioning}
\usetikzlibrary{shadows}

\tikzstyle{every entity} = [top color=white, bottom color=blue!30,
                           draw=blue!50!black!100, drop shadow]
\tikzstyle{every weak entity} = [drop shadow={shadow xshift=.7ex,
                                             shadow yshift=-.7ex}]
\tikzstyle{every attribute} = [top color=white, bottom color=yellow!20,
                              draw=yellow, node distance=1cm, drop shadow]
\tikzstyle{every relationship} = [top color=white, bottom color=red!20,
                                  draw=red!50!black!100, drop shadow]
\tikzstyle{every isa} = [top color=white, bottom color=green!20,
                        draw=green!50!black!100, drop shadow]

\begin{tikzpicture}[node distance=1.5cm, every edge/.style={link}]
  \node[entity] (emp) {Employee};
  \node[attribute] (ename) [above=of emp] {Name} edge (emp);
  \node[attribute] (enum) [above right=of emp] {\key{Number}} edge (emp);

  \node[isa] (isa) [below=1cm of emp] {ISA} edge (emp);

  \node[entity] (mec) [below left=1cm of isa] {Mechanic} edge (isa);
  \node[entity] (sal) [below right=1cm of isa] {Salesman} edge (isa);

  \node[relationship] (does) [left=of mec] {Does} edge (mec);

  \node[weak entity] (rep) [below=of does] {RepairJob} edge (does);
  \node[attribute] (rnum) [left=of rep] {\discriminator{Number}} edge (rep);
  \node[attribute] (desc) [above left=of rep] {Description} edge (rep);
  \node[attribute] (cost) [below left=of rep] {Cost} edge (rep);
  \node[attribute] (mat) [left=0.5cm of cost] {Parts} edge (cost);
  \node[attribute] (work) [below left=0.5cm of cost] {Work} edge (cost);

  \node[ident relationship] (reps) [below=of rep] {Repairs} edge [total] (rep);

  \node[entity] (car) [right=of reps] {Car} edge [<-] (reps);
  \node[attribute] (lic) [above=of car] {\key{License}} edge (car);
  \node[attribute] (mod) [below=of car] {Model} edge (car);
  \node[attribute] (year) [below right=of car] {Year} edge (car);
  \node[attribute] (manu) [below left=1.5cm of car] {Manufacturer} edge (car);
```

```

\node[relationship] (buy) [below=of sal] {Buys};
\node[attribute] (pri) [above left=of buy] {Price} edge (buy);
\node[attribute] (sdate) [left=of buy] {Date} edge (buy);
\node[attribute] (bval) [below left=of buy] {Value} edge (buy);

\node[relationship] (sel) [right=of buy] {Sells};
\node[attribute] (sdate) [above right=of sel] {Date} edge (sel);
\node[derived attribute] (sval) [right=of sel] {Value} edge (sel);
\node[attribute] (com) [below right=of sel] {Comission} edge (sel);

\draw[link] (car.10) -| (buy) (buy) edge (sal);
\draw[link] (car.-10) -| (sel) (sel) |- (sal);

\node[entity] (cli) [below right=0.5cm and 3.7cm of car] {Client};
\node[attribute] (cid) [right=of cli] {\key{ID}} edge (cli);
\node[attribute] (cname) [below left=of cli] {Name} edge (cli);
\node[multi attribute] (cphone) [below right=of cli] {Phone} edge (cli);
\node[attribute] (cadd) [below=of cli] {Address} edge (cli);

\draw[link] (cli.70) |- node [pos=0.05, auto, swap] {buyer} (sel);
\draw[link] (cli.110) |- node [pos=0.05, auto] {seller} (buy);
\end{tikzpicture}

```