# Tutorial of molecular generation and drug modification by MolAICal and deep learning model

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# 1. Introduction

In this tutorial, two examples are introduced: one is drug-like and FDA-like molecular generation that can be used for drug virtual screening, the other is scaffolds and groups modification based on a known ligand, which can be used to modify or design new drugs. For more detailed MolAICal, please read this paper (https://doi.org/10.1093/bib/bbaa161).

# 2. Materials

### 2.1. Software requirement

1) MolAICal: https://molaical.github.io

### 2.2. Example files

1) All the necessary tutorial files are downloaded from:
https://github.com/MolAICal/tutorials/tree/master/016-AImolecularGeneration

# 3. Procedure

### 3.1 Generate drug-like and FDA-like dataset

1) Generating FDA-like molecules.

```
#> molaical.exe -dock AI -s FDAMol -n 30 -nf 10 -nc 3 -g on -b on -v off
```

It will generate a file named tmpGenVS.dat that contains 30 molecular SMILES strings, and 3 folders named tmpGenMols1, tmpGenMols2, and tmpGenMols3. Users can generate much more molecules according to their needs. The generated 3D molecules are in PDBQT format by default. If users need to change the molecular format, for instance, they can use the below command for format conversion:

1) Adding hydrogen (option)

```
#> molaical.exe -dock addh -i 1.pdbqt
```

2) Changing “pdbqt” to “pdb” format

```
#> molaical.exe -dock pdbqt2pdb -i 1.pdbqt
```

2) Generating drug-like molecules.

```
#> molaical.exe -dock AI -s ZINCMol -n 30 -nf 10 -nc 3 -g on -b on -v off
```

It will generate a file named tmpGenVS.dat that contains 30 molecular SMILES strings, and 3 folders named tmpGenMols1, tmpGenMols2, and tmpGenMols3. Users can generate much more molecules according to their needs. The generated 3D molecules are in PDBQT format by default. If users need to change the molecular format, for instance, they can use the below command for format conversion:

1) Adding hydrogen (option)

```
#> molaical.exe -dock addh -i 1.pdbqt
```

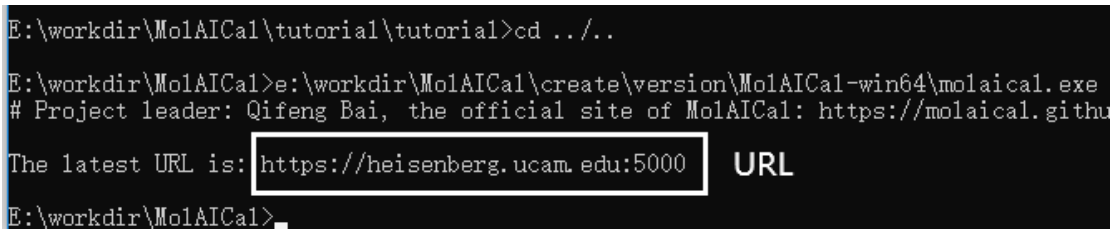
2) Changing “pdbqt” to “pdb” format

#> molaical.exe -dock pdbqt2pdb -i 1.pdbqt

### 3.2 Generate new similar molecules based on a known ligand

Webserver could supply a convenient way for the researchers to design drugs without any special software and hardware requirements via the browsers. MolAICal supplies this function via webserver which URL can be obtained by the below command:

#> molaical.exe -model ligdream




1) Input URL https://heisenberg.ucam.edu:5000 into the browser, you can choose the way for drawing your molecule or input your SMILES string (see Figure 1). Finally, click “Submit and Running”.

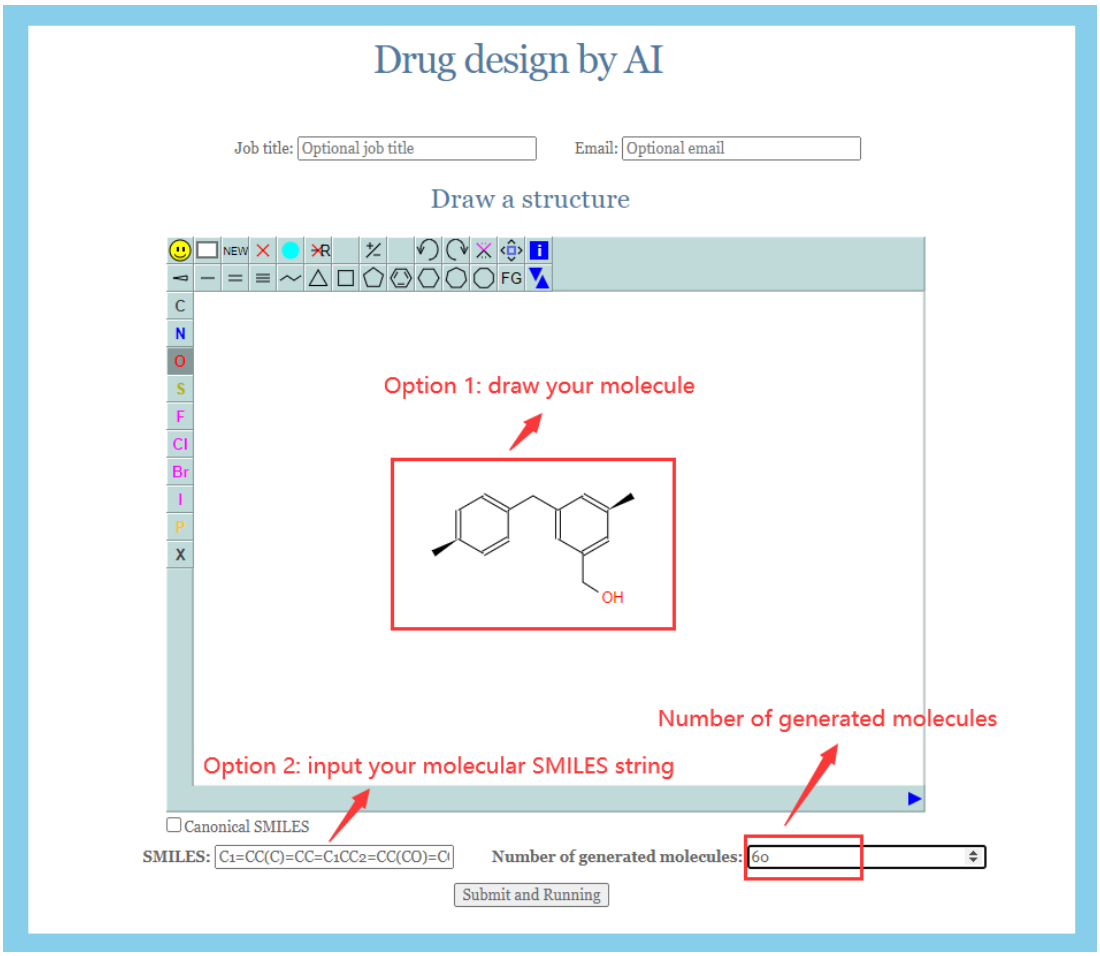



**Figure 1**

2) It will turn to another result web page (see Figure 2).

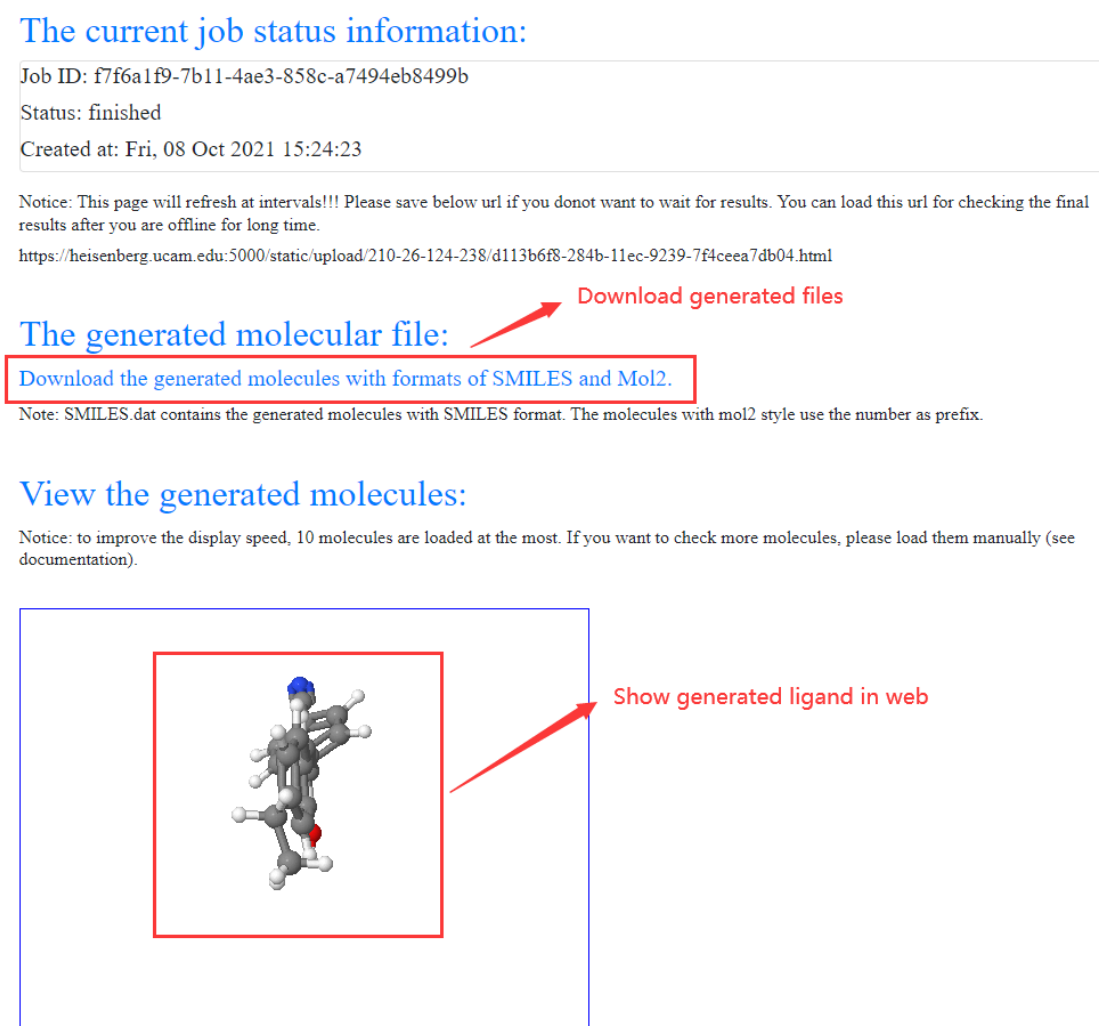



**Figure 2**