



# Solve Dinner Planning with CSP

MSI - DIMA - Task 1B

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[github.com/johannesbrandenburger/htwg-msi-dima](https://github.com/johannesbrandenburger/htwg-msi-dima)

# Approach

- formulate dependencies
- build CNF (clauses)
- create own simple SAT algorithm
  - search for unit clauses („H")
  - add them to result
  - eliminate them and their negations in the clauses
  - recursively call the function with additional unit clauses

# Implementation

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## Abbreviations

Mr H  
Mrs W  
Emma E  
Georg G  
Ivana I

## Constrains in CNF

```
(-H or W)      -> ["-H", "W"]  
(I or G)       -> ["I", "G"]  
(W or E)       -> ["W", "E"]  
(not W or not E) -> ["-W", "-E"]  
(-E or G)      -> ["-E", "G"]  
(-G or E)      -> ["-G", "E"]  
(-I or G)      -> ["-I", "G"]  
(-I or H)      -> ["-I", "H"]
```

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```
def remove_unit_clauses(result, clauses):
    while True:
        unitClauses = []
        for clause in clauses:
            if len(clause) == 1 and clause[0] not in unitClauses:
                unitClauses.append(clause[0])
        if len(unitClauses) == 0:
            break

        # remove all clauses that contain unit clauses (literals)
        for (i, clause) in enumerate(clauses):
            for unitClause in unitClauses:
                if unitClause in clause:
                    clauses[i] = None
        clauses = [clause for clause in clauses if clause is not None]

        # remove all negated unit clauses (literals) from all clauses
        for (i, clause) in enumerate(clauses):
            for unitClause in unitClauses:
                if neg(unitClause) in clause:
                    clauses[i].remove(neg(unitClause))

        # add the unitClauses to the result
        for unitClause in unitClauses:

            # if unitClause is already negated in the result -> no solution
            if neg(unitClause) in result:
                return [], clauses

            if unitClause not in result:
                result.append(unitClause)

    return unique(result), clauses
```

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```
def simple_csp_solver(result: list[str], clauses: list[list[str]]):  
  
    # first remove all unit clauses  
    result, clauses = remove_unit_clauses(result, clauses)  
  
    # if null clause is present, return an empty list  
    for clause in clauses:  
        if len(clause) == 0:  
            return []  
  
    # if no clauses are left, return the result  
    if len(clauses) == 0:  
        return result  
  
    # call recursively with two new clauses  
    literal = clauses[0][0]  
    clauses_1 = clauses + [[literal]]  
    clauses_2 = clauses + [[neg(literal)]]  
    result_1 = simple_csp_solver(result, clauses_1)  
    if len(result_1) > 0:  
        return result_1  
    return simple_csp_solver(result, clauses_2)  
  
# solve the dinner planning problem  
constrains = [...] # see markdown  
should_solution = ["-H", "-W", "-I", "G", "E"] # found by brute force  
is_solution = simple_csp_solver([], constrains)  
print("should_solution: ", should_solution) # ['-H', '-W', '-I', 'G',  
print("is_solution: ", is_solution) # ['-H', '-I', '-W', 'E', 'G']  
assert(sort_array(should_solution) == sort_array(is_solution))
```



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