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# Multiway Dataflow Constraint System and UI Programming

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# Chapter 1

## Introduction

This report is part of my INF319 project at the University of Bergen (UiB). The goal of the project was to understand event-based Graphical User Interface (GUI) programming and the limitation to such programming. Specify dataflow constraints and understand how they connect to GUI widgets. Understand the possibilities and limitations of constraint systems based on GUIs. The multiway dataflow constraint system used in the development of this project is HotDrink. Before developing this project I had no prior experience with HotDrink.

TODO: Skriv hva rapporten inneholder.

## 1.1 Constraint systems

A constraint system can be seen as a tuple  $\langle V, C \rangle$ , where  $V$  is a set of *variables* and  $C$  a set of *constraints*. Each variable in  $V$  has a associated value of a given type (string, integer, boolean, object, etc.). Each constraint in  $C$  is a tuple  $\langle R, r, M \rangle$ . The variables involved in the constraint is given by  $R \subseteq V$ ,  $r$  is some  $n$ -ary relation among variables in  $R$ , where  $n = |R|$ .  $M$  is a set of non-empty set of *constraint system methods*. Executing any method  $m$  in  $M$  enforces the constraint by computing values for some subset of  $R$ , using another disjoint subset of  $R$  as inputs, such that the relation  $R$  is satisfied [2].

## 1.2 HotDrink

In this project I used the multiway dataflow constraint system library HotDrink [1], which is a JavaScript-based library for multiway dataflow constraint systems in GUIs. Instead of writing explicit event handlers, the programmer writes declarative specification of data dependencies, from which the library derives the GUI behavior. This library features a DSL for defining constraint systems. The DSL allows one to specify *components*, *constraints*, *methods* and *variables*. A component in HotDrink holds a set of constraints and variables, as described in section 1.1. Variables often depend on each other, in that case it gets into a setting of multi-way dataflow.

The HotDrink DSL is implemented JavaScript tagged template literals<sup>1</sup>, which can be seen in Listing 1.1. This lets the programmer integrate the library with frontend JavaScript frameworks such as React<sup>2</sup> and Svelte<sup>3</sup>.

Listing 1.1: Example of the HotDrink DSL

```
1 import { component } from 'hot-drink';
2
3 const comp = component`
4   var f=1337, c;
5
6   constraint c1 {
7     m1(c -> f) => c * (9/5) + 32;
8     m2(f -> c) => (f -32) * 5/9;
9   }
10 `;
```

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<sup>1</sup>Template literals

<sup>2</sup>For more information about the framework can be found at [reactjs.org](https://reactjs.org)

<sup>3</sup>For more information about the framework can be found at [svelte.dev](https://svelte.dev)

# List of Acronyms and Abbreviations

**DSL** Domain Specific Language.

**GUI** Graphical User Interface.

**UiB** University of Bergen.



# Bibliography

- [1] Gabriel Foust, Jaakko Järvi, and Sean Parent. Generating reactive programs for graphical user interfaces from multi-way dataflow constraint systems. In *Proceedings of the 2015 ACM SIGPLAN International Conference on Generative Programming: Concepts and Experiences*, GPCE 2015, page 121–130, New York, NY, USA, 2015. Association for Computing Machinery. ISBN 9781450336871. doi: 10.1145/2814204.2814207.  
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- [2] Jaakko Järvi, Mat Marcus, Sean Parent, John Freeman, and Jacob Smith. Algorithms for user interfaces. In *Proceedings of the Eighth International Conference on Generative Programming and Component Engineering*, GPCE '09, page 147–156, New York, NY, USA, 2009. Association for Computing Machinery. ISBN 9781605584942. doi: 10.1145/1621607.1621630.  
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