Flow-based programming: NodeRed

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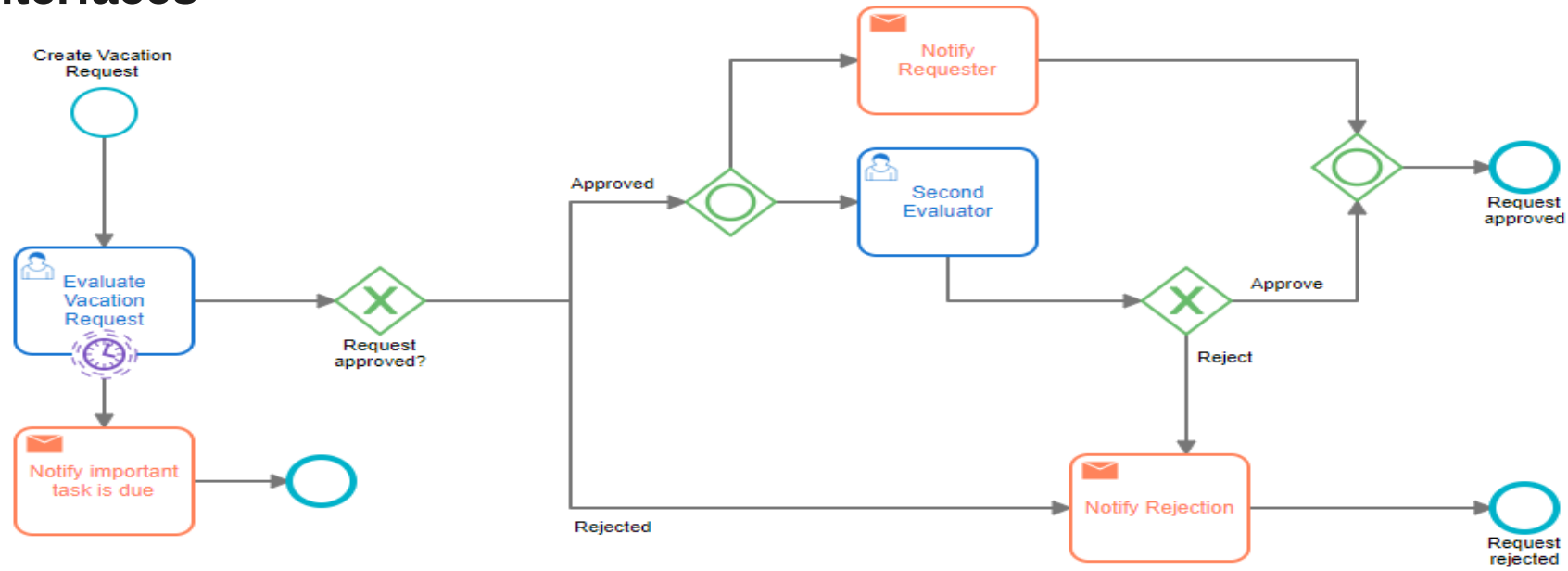
Flow-based programming

No-code programming style:

- **Connect functional modules**
- **Configure their properties**
- **Build User Interfaces**



Node-RED (http://nodered.org)

Flow-based visual programming tool created initially by IBM for IoT

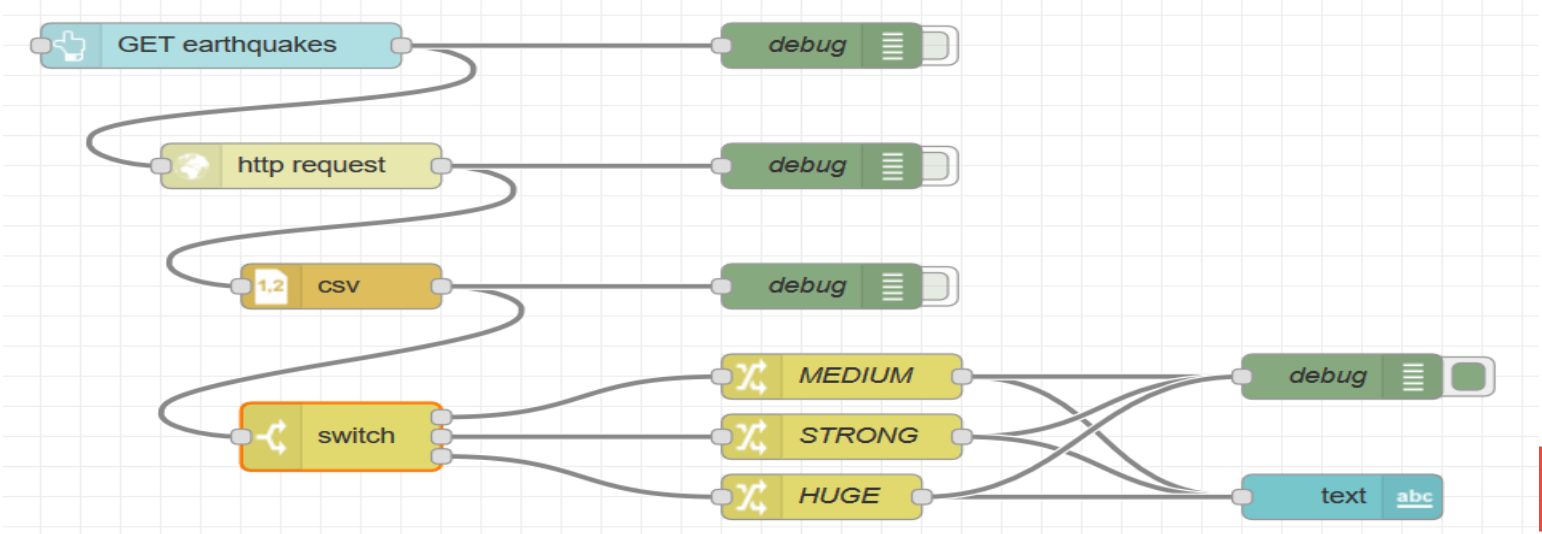
Interconnected JavaScript functional units (installed with NPM)

Wires communicate messages (Javascript objs/dictionaries) aggregating all data

- **functional units get / add data to the messages and/or remember info locally**
- **messages can be split / joined into message sequences**

Inherently parallel

A node could contain full programs



Concepts

Flow: a graph of interconnected nodes

Node: a functional unit (JavaScript program) triggered by message / event

Context: a blackboard to share / store data at node / flow / global level

Wire: a bus interconnecting two nodes, transmitting messages

Message: a Javascript object/dictionary of info passed from node to nodes

Subflow: a node containing a flow (==> hierarchical flows)

Group: a grouped set of nodes with label (for documentation)

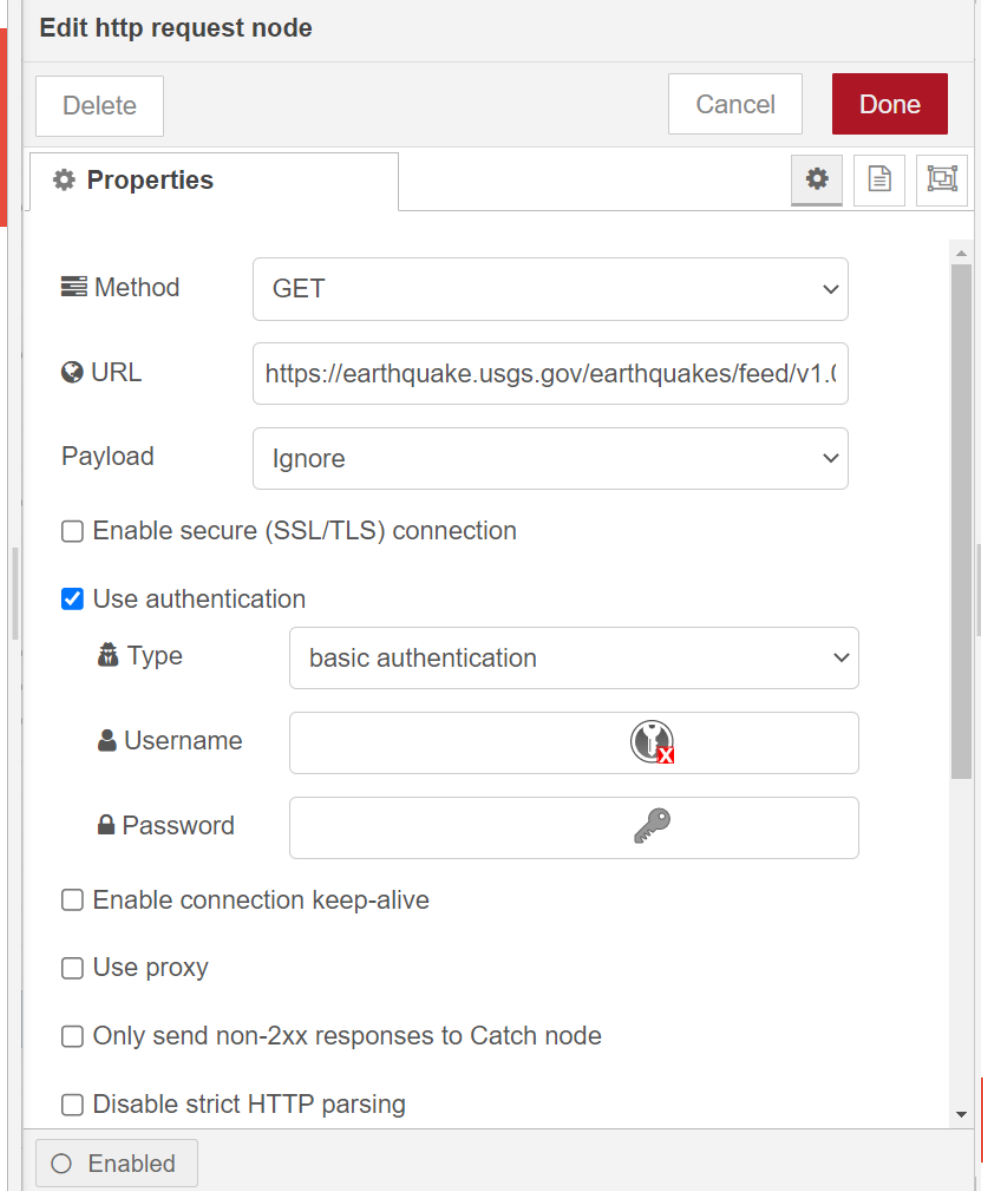
Function node: a programmable node updating the message (or blocking it)

Node properties

All nodes have properties that define how they work

E.g. the HTTP request

- Type of method
  (GET/POST/PUT/DELETE/from parameter)
- URL
- what to do with the msg payload activating this
- authentication / proxy … etc
- headers
- what to return



Features

Typed wires?	NO	(messages / JS dictionaries)
Functions?	YES	(in JavaScript, inside a node)
Functional programming?	NO?	(in Javascript, inside a node)
Recursion?	YES	(in Javascript, inside a node)
Loops?	YES	(in Javascript or with a node)
External languages?	NO?	(some app in a node server?)
File I/O	YES?	(in Javascript, inside a node)
Modularization?	YES	(Subflows)
Concurrency?	YES	

Programming style

Low level programming is done in JavaScript in function nodes (if required)

Flows: higher level programming (organization, data exchange)

Good to blend many already available nodes + some personalized

Data exchange style: blackboard messages (JavaScript dictionaries)

- every node can read / write / modify messages from the stream
- there could be many “blackboards” if there are many paths

Some synchronization pattern is slightly cumbersome?

- wait for K data on the stream (count and keep memory)
- wait for K data from different streams (check for all present)

A huge palette of available Flows/Nodes
https://flows.nodered.org

Microcontrollers:

- Raspberry Pi
- Arduino

Applications:

- Mysql/… databases
- Excel/… spreadsheets

Application fields

- IoT
- AI
- Crypto
- …

Home automation:

- Alexa
- Google Home
- Tuya smart
- Home appliances
- Fritz!Box routers
- Printers
- Vacuum (Roomba …)
- Washers (Miele …)
- …

Node Red to teach Computational Thinking?

PRO

- reuse and connection of functional units
- communication between different servers
- problem mapped to flow of information
- a flow is like a pipeline of transformations
- …

CON

- good Javascript knowledge req.
- not obvious synchronization
- no data typing visualized
- …

Demo

EXAMPLES