Functional Domain Modeling

amazon.it

Riepilogo ordine (1 articolo)

1 Indirizzo di consegna

Modifica

Cosa succede se non sono a casa? Indica dove possiamo lasciare il tuo pacco
Oppure seleziona un punto di ritiro - Scegli

2 Modalità di pagamento

VISA **Visa / Electron** termina cor

Modifica

Indirizzo di fatturazione: Giovanni .

Aggiungi un buono regalo o un codice promozionale

Inserisci codice | Inserisci

3 Rivedi gli articoli e la spedizione

amazon prime

Giovanni, come cliente Amazon Prime risparmi EUR 5,99 sulle spese di spedizione di questo ordine con la Spedizione 1 giorno senza costi aggiuntivi.
Ti ringraziamo per essere un cliente Amazon Prime. Approfitta di consegne illimitate in 1 giorno su oltre 2 milioni di prodotti e in 2-3 giorni su molti altri milioni.

Data di consegna garantita: 6 feb. 2019 Se effettui l'ordine nei prossimi 3 ore e 48 minuti (Dettagli)
Articoli di Amazon.it

BRITA filtri MAXTRA+ Pack 6, Cartucce per caraffe filtranti, 6 filtri x 6 mesi di acqua filtrata
EUR 24,56 prime
Q.tà: 1
Venduto da: Amazon EU S.a.r.L.
Disponibilità immediata.
Aggiungi opzioni regalo

L'articolo arriva in un imballaggio che rivela il contenuto. Per nasconderlo, scegli **Spedizione in imballaggio Amazon.**

Spedizione in imballaggio Amazon

Scegli la tua modalità di spedizione Prime:
- (•) GRATIS 1 giorno — Consegna garantita entro domani 6 feb.
- ( ) GRATIS Standard - Consegna venerdì 8 feb.

Acquista ora

Confermando il tuo ordine accetti integralmente le nostre Condizioni generali di uso e vendita. L'acquisto sarà completato solo con la conferma di spedizione. Prendi visione della nostra Informativa sulla privacy, della nostra Informativa sui Cookie e della nostra Informativa sulla Pubblicità definita in base agli interessi.

Riepilogo Ordine

Articoli:	EUR 24,56
Costi di spedizione:	EUR 0,00
Totale ordine:	**EUR 24,56**

Il totale ordine include l'IVA. Dettagli

Come vengono calcolate le spese di spedizione?

Scopri come modificare le preferenze per le consegne il sabato. Ti ricordiamo che il servizio è disponibile solo in alcune aree..

Tutti gli articoli che possono essere spediti con Amazon Prime saranno inviati con tale opzione.

```ts
type ShippingAddress = {
  name: string;
  street: string;
  city: string;
  cap: string;

  isCompanyPickup: boolean;
  pickupCompany?: string;
}
```

```
type Step = (info: CheckoutInfo) => CheckoutInfo

function checkout(info: CheckoutInfo): CheckoutInfo {
  return processShippingAddress(info)
       .then(processPaymentMethod)
       .then(processShippingCourier)
       .then(validate)
       .then(confirmCheckout)
}
```

Assumptions

- FP concepts
  - purity
  - composition
  - immutability
- Functor, Applicative, Monad, Semigroup/Monoid

Domain Model [1]

1. **Entities**
2. **Behaviours**
3. Ubiquitous language

[1] Domain Driven Design

1. Model entities with **immutable** Algebraic Data Types (ADT)
2. Model behaviours as pure functions in modules
3. Behaviours operate on the types of the entities

```ts
export type ShippingAddress = Readonly<{
  name: string;
  street: string;
  city: string;
  cap: string;

  isCompanyPickup: boolean;
  pickupCompany?: string;
}>;

export type PaymentMethod = Readonly<{
  paymentMethod: string;
  cardNumber: string;
  cardExpiration: string;
  cardCode: string;
}>;

export type ShippingCourier = Readonly<{
  shippingMethod: string;
  estimate: number;
}>;

export type CheckoutInfo = ShippingAddress & PaymentMethod & ShippingCourier;
```

```ts
import { ShippingAddress, PaymentMethod, ShippingCourier } from "./domain.ts";

export function processShippingAddress(info: CheckoutInfo): CheckoutInfo {}

export function processPaymentMethod(info: CheckoutInfo): CheckoutInfo {}

export function processShippingCourier(info: CheckoutInfo): CheckoutInfo {}

export function validate(info: CheckoutInfo): CheckoutInfo {
  if (!info.cardCode) throw new Error('Invalid card');

  return info;
}

export function confirmCheckout(info: CheckoutInfo): CheckoutInfo {}
```

Algebraic Data Types

Sum type

Union of sets.

```
type PaymentMethod = 'visa' | 'mastercard'

//: < l1: 'visa', l2: 'mastercard' >
```

Option

```
type Option<A> =
  | { type: 'None' }
  | {
      type: 'Some',
      value: A
    }
```

When to use sum types?

To model the variations within an entity

```ts
export type ShippingAddress = Readonly<{
  name: string;
  street: string;
  city: string;
  cap: string;

  isCompanyPickup: boolean;
  pickupCompany: Option<string>;
}>;

type PaymentMethod = 'Visa' | 'Mastercard'
export type PaymentMethod = Readonly<{
  paymentMethod: PaymentMethod;
  cardNumber: string;
  cardExpiration: string;
  cardCode: string;
}>;

type ShippingMethod = 'Prime' | 'Standard';
export type ShippingCourier = Readonly<{
  shippingMethod: ShippingMethod;
  estimate: number;
}>;
```

Pattern matching

```
function getCourier(shippingMethod: ShippingMethod) {
  switch (shippingMethod) {
    case 'Standard':
      return 3;
    case 'Prime':
      return 1;
    // No default case
  }
}
```

Sum types vs Inheritance

```
interface ShippingMethod {...}
class PrimeMethod implements ShippingMethod {...}
class StandardMethod implements ShippingMethod {...}
```

```ts
type CardType = 'Visa' | 'Mastercard'
type CardPayment = Readonly<{
  type: 'CardPayment';
  card: CardType;
  cardNumber: string;
  cardExpiration: string;
  cardCode: string;
}>;

type CashPayment = {
  type: 'CashPayment';
}

type ChequePayment = {
  type: 'ChequePayment';
}

export type PaymentMethod = CardPayment | CashPayment | ChequePayment
```

Inheritance cons

— What is the common behaviour?

— State and behaviour coupling

— Data and code is scattered around many locations

```ts
export interface Field {
  id: string;
  type: string;
  value: any;
}

export interface TextField extends Field {
  id: string;
  type: 'text';
  value: string;
}

export interface ListField extends Field {
  id: string;
  type: 'list';
  value: Array<string>;
}
```

```ts
export interface TextField {
  id: string;
  type: 'text';
  value: string;
}

export interface ListField {
  id: string;
  type: 'list';
  value: Array<string>;
}

export type Field = TextField | ListField
```

Product type

Product of sets.

```
type ShippingMethod = 'Prime' | 'Standard'
type CourierTuple = [ShippingMethod, number]

//: ShippingMethod * number
```

Product type

```
type CourierRecord = {
  shippingMethod: 'Prime' | 'Standard';
  estimate: number;
};
```

Tuple <=> Record

There is an isomorphism between the types **tuples** and **record**

```
from . to = to . from = identity

function toRecord(tuple: CourierTuple): CourierRecord {
  return { shippingMethod: tuple[0], estimate: tuple[1] }
}

function fromRecord(record: CourierRecord): CourierTuple {
  return [record.shippingMethod, record.estimate]
}
```

When to use product types?

To model the related data which form larger abstractions.

NonEmptyArray

```
type NonEmptyArray<A> = {
  head: A;
  tail: Array<A>
}
```

Sum types again

Sum types again - Atomic updates

```
export type ShippingAddress = Readonly<{
  name: string;
  street: string;
  city: string;
  cap: string;

  isCompanyPickup: boolean;
  pickupCompany: Option<string>;
}>;
```

Sum types again - Atomic updates

```
type HomePickup = { type: 'HomePickup' }
type CompanyPickup = { type: 'CompanyPickup', pickupCompany: string }
type PickupType = HomePickup | CompanyPickup

export type ShippingAddress = Readonly<{
  name: string;
  street: string;
  city: string;
  cap: string;

  pickup: PickupType;
}>;
```

Sum types again - Either

```
type Either<L, R> =
  | {
      type: 'Left',
      left: L
    }
  | {
      type: 'Right',
      right: R
    }
```

Either

```
import { left, right } from 'fp-ts/lib/Either';

export function verifyPaymentMethod(payment: PaymentMethod)
  : Either<string, PaymentMethod> {
  if (!payment.cardCode) return left('Invalid card');

  return right(payment);
}
```

Either Monad - Fail fast

```
export function verifyShippingAddress(address: ShippingAddress)
  : Either<string, ShippingAddress> {}

export function verifyPaymentMethod(payment: PaymentMethod)
  : Either<string, PaymentMethod> {}

export function verifyCheckoutInfo(checkoutInfo: CheckoutInfo)
  : Either<string, CheckoutInfo> {
  // Structural subtyping
  return verifyShippingAddress(checkoutInfo)
    .chain(verifyPaymentMethod)
}
```

Validation Applicative - Accumulate failures

```
import { validation, failure, success } from 'fp-ts/lib/Validation'
import { traverse } from 'fp-ts/lib/Array'

export function verifyShippingAddress(address: ShippingAddress)
  : Validation<NonEmptyArray<string>, ShippingAddress> {}

export function verifyPaymentMethod(payment: PaymentMethod)
  : Validation<NonEmptyArray<string>, PaymentMethod> {}

export function verifyCheckoutInfo(checkoutInfo: CheckoutInfo)
  : Validation<NonEmptyArray<string>, CheckoutInfo> {
  const validators = [verifyShippingAddress, verifyPaymentMethod];
  return traverse(validation)(validators, f => f(checkoutInfo))
}

// failure(new NonEmptyArray("Invalid address", ["Invalid card"]))
verifyCheckoutInfo({ ... })
```

UI State

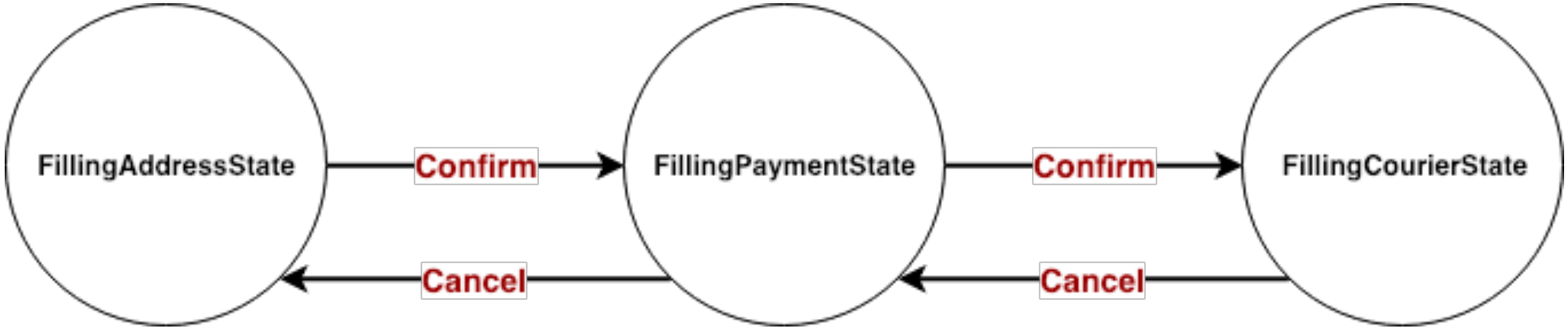
Make illegal states unrepresentable

```
type State = {
  isFillingAddress: boolean;
  isFillingPayment: boolean;
  isFillingCourier: boolean;
} & CheckoutInfo

class CheckoutForm extends React.Component<{}, State> {
  state: State = {
    isFillingAddress: true,
    isFillingPayment: false,
    isFillingCourier: false,

    name: '';
    street: '';
    city: '';
    ...
    paymentMethod: '';
    cardNumber: '';
    cardExpiration: '';
    cardCode: '';
  }

  render() {
    return (
      <form> ... </form>
    );
  }
}
```

```
type FillingAddressState = { type: 'FillingAddressState' }
  & ShippingAddress

type FillingPaymentState = { type: 'FillingPaymentState' }
  & ShippingAddress & PaymentMethod

type FillingCourierState = { type: 'FillingCourierState' }
  & ShippingAddress & PaymentMethod & ShippingCourier


type State =
  | FillingAddressState
  | FillingPaymentState
  | FillingCourierState
```

```
class CheckoutForm extends React.Component<{}, State> {
  state: State = {
    type: 'FillingAddressState',

    name: '';
    street: '';
    city: '';
    cap: '';
    pickup: { type: 'HomePickup' }
  }

  render() {
    switch (this.state.type) {
      case 'FillingAddressState':
        return this.renderAddressFields();
      case 'FillingPaymentState':
        return this.renderPaymentFields();
      case 'FillingCourierState':
        return this.renderCourieFields();
    }
  }
}
```

Finite state machine



Finite state machine

— Each state has different possible data

— Forces to think about possible states

— States and transitions are types

Phantom Types

```ts
type FormData<A> = CheckoutInfo;

type Unvalidated = { type: 'Unvalidated' }
type Validated = { type: 'Validated' }

function createFormData(data: CheckoutInfo)
  : FormData<Unvalidated> {}

function setShippingAddress(data: FormData<Unvalidated>, address: ShippingAddress)
  : FormData<Unvalidated> {}

function validate(data: FormData<Unvalidated>)
  : FormData<Validated> {}

function confirmCheckout(data: FormData<Validated>)
  : FormData<Validated> {}
```

References

— Functional and Algebraic Domain Modeling - Debasish Ghosh - DDD Europe 2018

— Domain Modeling Made Functional - Scott Wlaschin

— Functional and Reactive Domain Modeling

— Algebraic Data Types - Giulio Canti