2016年度 数理科学III

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11/1(火) 第5回数理科学IIIB

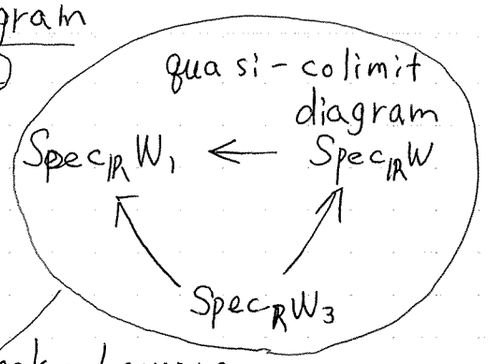
quasi-colimit diagram (Weil代数)

limit diagram

$W_1 \to W_2$

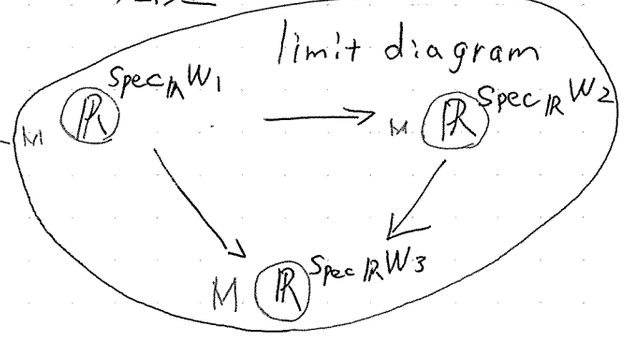
$\searrow \swarrow$

W_3



Kock-Lawvere の公理

任意の quasi-colimit diagram



limit diagram になっている

micro linear space M 主なる研究対象

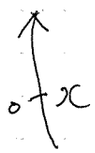
$M \ni x$

$T_x M$ 点xでの 接空間

$t: D \to M \qquad t(0) = x$

接ベクトル

$T_x M = \{t : D \to M : t(0) = x\}$



スカラー倍 $(\alpha t)(d) = t(\alpha d)$

足し算

$1 = \{0\}$

$$\begin{array}{ccc} 1 & \to & D \\ \downarrow & & \downarrow i_2 \\ D & \xrightarrow[i_1]{} & D(2) \end{array} \qquad \begin{array}{ccccc} M = M^1 & \leftarrow & M^D & \ni & t_1, t_2 \in TxM \\ \uparrow & & \uparrow & & \\ t_1 \in M^D & \leftarrow & M^{D(2)} & & \end{array}$$

$\exists!$ $\ell_{(t_1,t_2)} : D(2) \to M$

$0(d) = x$

$\ell_{(t_1,t_2)}(d,0) = t_1(d)$

$\ell_{(t_1,t_2)}(0,d) = t_2(d)$

$(t_1 + t_2)(d) = \ell_{(t_1,t_2)}(d,d)$

線型空間 $d \in D$, $\alpha \in \mathbb{R} \Rightarrow \alpha d \in D$

(1) $(t_1 + t_2) + t_3 = t_1 + (t_2 + t_3)$ $\quad \ell_{(\alpha t_1, \alpha t_2)} = \ell_{(t_1,t_2)}(\alpha d_1, \alpha d_2)$

(2) $t_1 + t_2 = t_2 + t_1$

(3) $t + 0 = 0 + t = t$

(4) $1t = t$

(5) $\alpha(t_1 + t_2) = \alpha t_1 + \alpha t_2$

(6) $\alpha(\beta t) = \alpha\beta(t)$

(7) $(\alpha + \beta)t = \alpha t + \beta t$

(5) $(\alpha(t_1+t_2))(d) = (t_1+t_2)(\alpha d) = \ell_{(t_1,t_2)}(\alpha d, \alpha d)$

$(d_1, d_2) \to \ell_{(t_1,t_2)}(\alpha d_1, \alpha d_2)$

$d_1 d_2 = 0$

$D(2) \ni (d_1, d_2) \mapsto t(\alpha d_1 + \beta d_2) \in M$

$t(\alpha d) = (\alpha t)(d)$

$t(\beta d) = (\beta t)(d)$

確認

(4) $(1t)d = t(1d) = t(d)$

(6) $\alpha(\beta t)(d) = (\beta t)(\alpha d) = t(\beta\alpha d) = t((\alpha\beta)d) = (\alpha\beta)(t))(d)$

(7) $((\alpha+\beta)t)(d) = (\alpha t + \beta t)(d) = \ell_{(\alpha t, \beta t)}(d,d) = t((\alpha+\beta)d)$

~~$(d_1, d_2) \Longrightarrow$ $t(d_1)$~~

(3) $(t+0)(d) = l_{(t,0)}(d,d)$ $\quad (d_1, d_2) \mapsto t(d_1)$

$(d, 0) \quad t(d)$

$(0, d) \quad t(0) = x$

(2) $(t_1 + t_2)(d) = l_{(t_1,t_2)}(d,d)$

$(d_1, d_2) \longmapsto l_{(t_2,t_1)}(d_2, d_1)$

$(d, 0) \longrightarrow$

$= l_{(t_2,t_1)}(d, d)$

(1) $((t_1+t_2)+t_3)(d)$

$t_1, t_2, t_3 \in T_xM$

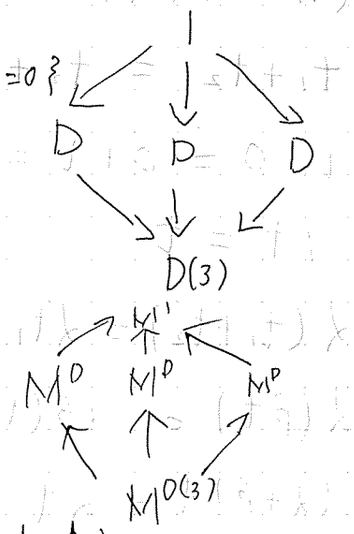
$D(3) = \{(d_1,d_2,d_3) \in D \times D \times D \mid d_1d_2 = d_2d_3 = d_1d_3 = 0\}$

$l_{(t_1,t_2,t_3)} : D(3) \to M$

$l_{(t_1,t_2,t_3)}(d,0,0) = t_1(d)$

$l_{(t_1,t_2,t_3)}(0,d,0) = t_2(d)$

$l_{(t_1,t_2,t_3)}(0,0,d) = t_3(d)$



$l_{(t_1,t_2)}$

$t_1 + t_2$

$D(2) \ni (d_1, d_2) \longmapsto l_{(t_1,t_2,t_3)}(d_1, d_2, 0)$

$D(2) \ni (d_1, d_2) \longmapsto l_{(t_1,t_2,t_3)}(d_1, d_2, d_2)$

$(t_1 + t_2)(d) = l_{(t_1,t_2,t_3)}(d,d,0)$

$l_{(t_1,t_2,t_3)}(d,d,0) = (t_1 + t_2)(d)$

$((t_1+t_2)+t_3)(d) = l_{(t_1,t_2,t_3)}(d,d,d)$

$(t_2+t_3)(d) = l_{(t_1,t_2,t_3)}(0,d,d)$

$(d_1, d_2) \longmapsto l_{(t_1,t_2,t_3)}(0, d_1, d_2)$

$t_1 + (t_2 + t_3)$

$D(2) \ni (d_1, d_2) \mapsto l_{(t_1,t_2,t_3)}(d_1, d_2, d_2)$